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ABSTRACT

This handbook of research findings and practical suggestions is written for teachers, educators, and psychologists who are concerned about computer literacy for adults. Based on a federally funded research project, the handbook focuses on the computer needs of non-traditional adult learners over 25 years of age. The first section examines contemporary trends and problems of adult computer education. The second section deals with the psychology of the learning processes involved in acquiring basic computer skills, including methods for computer education research; computer literacy for adults; types of computer literacy for adults; the educational structure for teaching computer skills to adults; and adult learners and their individual differences. Factors impairing or facilitating the rate of learning to use a computer for adults are also addressed. The third section includes a survey comparing the computer learning patterns of 55 adult learners with 55 traditional college students, and concludes with 18 suggestions for teaching, learning, and policy making concerned with computers and adults. A glossary of commonly used terms and references are included. (Author/DJR)

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FACILITATING THE ACQUISITION OF COMPUTER SKILLS FOR ADULTS

A Handbook Of Findings And Recommendations

christopher j. mruk, ph.d.

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A Handbook of Findings and Recommendations

Christopher J. Mruk, Ph.D.

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FACILITATING THE ACQUISITION OF COMPUTER SKILLS FOR ADULTS:
A Handbook of Findings and Recommendations

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Table of Contents

I. Part One: Introduction to the Problem of Adult Computer Education

A. The Growing Problem of a Technological Poverty Line 1
  Overview: Who this handbook is for and how its organized .. 2
  Intended audience and limitations 3
  Organization 5
  Background 7
B. The Current Status of Computer Education for Adults 8
  Problems, issues and the need for this project 8
  Metaphors of change 9
  Computers and the educational crisis 10
C. The American Situation 12
  Special issues 12
  Current American trends 14
  Other problems for adults 18
  Current trends and progress 20
D. Summary 25

II. Part Two: The General Structure of Computer Education For Adults

A. Methodological Issues in Computer Education Research 26
  Finding acceptable methods 26
  A general structure 27
B. Computer Literacy for Adults: What is it? 28
  Method 28
  Preliminary findings: Computer literacy in general 30
C. Adult Types of Literacy 31
  Pre-literacy 32
  Computer appreciation 34
  User awareness 35
  Computer competence 38
  Computer skill or "fluency" 40
  The learning structure 41
D. The Educational Structure of Computer Educating Adults 43
  Method 43
  The professional model 44
  Academic model 45
  Structured workshop training 47
  Informal learning format 48
  Universal teaching orientation 49
  The educational structure 51
E. The Individual Adult Learner 53
  The learner structure 53
  Adult learning patterns 53
F. Individual Differences 60
  Personal factors 61
  Computers, anxiety and learning 63
G. The General Structure of Acquiring Computer Skills For Adults 67

III. Part Three: Adult Experience and Recommendations

A. A Study of Adults Acquiring Computer Skills 69
  Survey aims 69
  Design 70
  Sample 71
  Methods 72
  Findings 74
B. Recommendations 82
  Research and teaching/learning recommendations 83
    Research needs and priorities 83
    Teaching factors 85
    Teaching techniques 89
    Learner oriented suggestions 94
  Policy and administrative recommendations 99
    Adult computer education sources (ACES) 101
  Conclusion 105

VI. Glossary of Commonly Used Terms 107

V. References 108

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Researching a new and rapidly developing area always involves more work than just extending previous knowledge. Because there are fewer established thinkers and guidelines to follow, many extra hours are required to answer such basic questions as which directions and methods might be most promising. The principle researcher must often rely on others for helpful suggestions when doing such research. All those already acknowledged as participants are thanked in this regard. Special acknowledgement is extended to Gloria Hahn, Jeff Quin, Joyce Taylor, Adrian Baylock and Denise Powers. The generous, spontaneous support provided by Firelands College, Bowling Green State University of Ohio must also be acknowledged. Finally, the highest degree of appreciation is for Marsha Oliver Mruk whose graduate paper on technophobia inspired the idea for this project, and whose support nourished it to completion.

PART ONE: INTRODUCTION TO THE PROBLEM OF ADULT COMPUTER EDUCATION

Introduction: The Growing Problem of a Technological Poverty Line

Word processing, databases, electronic spreadsheets, bits, bytes and booting up the system are some of the familiar buzzwords of the "Information Age". However, another set of commonly used terms point to the other side of computerization. Blue collar unemployment, job displacement, job retraining and computer illiteracy express possible negative consequences of the computer revolution. This handbook is concerned with the social and economic dangers of the computer's dark side. More specifically, we are attempting to deal with the growing problem of helping the "average" adult to acquire the basic kinds of computer skills that are necessary to cope with the computerization of America. What kinds of computer skills do adults need most? Who is going to teach them? What are the most efficient ways to learn such skills? And what types of training programs suit adult learner needs most effectively? These are the kinds of questions that educators and administrators must address. We have examined them thoroughly, and can point the way to some of the solutions to what can be described as the growing problem of the technological poverty line.

One unique aspect of this handbook is that the computer needs of children or high school students are not among our concerns. As we shall see, considerable time and money is already being spent on those issues. Instead, our focus is on the computer learning needs and patterns of Americans between ages twenty-four and sixty-five. We see the adult learner as constituting the single most important group in need of computer education or training today. For they are the first men and women to face the danger of becoming the victims of mass computerization. Perhaps Congressman Albert Gore, Jr. says it best,

> "If the next generation and the present generation of citizens in this country are going to be able to cope with this anticipated sharp, dramatic, speedy transition, our educational and training institutions are going to have to gear up for a training and retraining effort unprecedented in all of human history. It's just that simple. I do not see any way around this educational challenge.
>
> But we are not ready to do that yet. We do not know which direction to move. However, we are already seeing the impending consequences if we do not move. Because if we stand still, if we do not adapt to this revolution and accelerate our nation's ability to adapt to this revolution, we will immediately suffer consequences in the international competition which is growing more intense daily" (SIGCSE, 1983, p.4).

Our project faces these issues head on. In addition to presentations at national scientific and educational conferences, the primary goal was to produce one of the first handbooks of research findings and educational suggestions specifically designed to aid the adult learner in this task. It is hoped that this "first clear look" at computer education for this crucial but poorly represented population will be of use to teachers, administrators and policy makers alike. The goal is to help prevent the creation of a new social and economic disability, and the unwanted formation of what we can only call the technological poverty line!

Overview: Who This Handbook is For, and How It's Organized

Intended Audience and Limitations

This handbook is designed to be used by both educators and administrators who are concerned with computer-learning adults. Additionally, the funding source for this project has encouraged publication. Therefore, we have also attempted to write for the educated layperson who is interested in what it means to become "computer literate", and how he or she might do so. Naturally, it is hoped that all adults in need of computer skills can benefit from the research findings, teaching suggestions, and policy recommendations which are provided in the following pages. However, because they have the greatest immediate need, we have targeted one group to be a special concern. These individuals are those millions of Americans of all groups and types who must support their own education and advancement. Men and women employed in white collar positions who need computer skills to advance or maintain their jobs are important to consider. The computer needs of service oriented, clerical and office personnel who are dealing with the effects of computerization in the office must be kept in mind. Above all, the problems of those who are facing displacement or job retraining are a major concern.

In short, we are primarily concerned with the so called "average" or "typical" American. For the most part, such an audience is composed of the large number of citizens who cannot rely on their employers, federal or state training programs to provide them with the opportunity to acquire meaningful computer skills. By 'meaningful' we mean skills which can [or have the potential to] be transfered to the job situation. We are not concerned with adults who are interested in the computer primarily for "personal enrichment". At the same time, the handbook does include information concerning adult learners of all types, and the suggestions can be modified to more specialized training needs and settings.

A deliberate attempt has been made to use clear, everyday language whenever possible. After all, we are dealing with a very large, incredibly diverse range of teacher backgrounds, administrative concerns and individual learner needs. Since our supporters are interested in the possibility of publishing this handbook, we have tried to write in the more conversational tone of a book rather than a technical report. However, it is impossible to escape the fact that the process of acquiring computer skills is a complex activity. Even the most basic understanding involves dealing with information related to the fields of computer science, psychology and education. How could it be otherwise at this early stage? Additionally, even though the information is provisional, it is important to be as accurate as possible. The handbook is founded on almost a year of study so that educators and policy makers can use the information with some confidence. This technical work involved both qualitative and quantitative research on very basic questions because so little work has been done to date. We even developed a pilot study that compared the responses of "typical" adults learning to operate a computer with regular college students! Even so, we have tried to present such research based information in a readable way.

Because we are dealing with such a new and complex area of human learning and performance, it is necessary to regard our work as being of an initial or pilot nature. Further work, including additional validation of our findings, is clearly needed. We look forward to it! Basic confidence can be taken from the fact that the findings and suggestions presented in this manual are either based on empirical evidence from our own work, or is supported by independently gathered evidence, or both. In addition to the original research that is presented, the larger value in providing this practically oriented "first clear look" is that it provides an accurate cognitive or educational "map" of computer education and training for adults as it is practiced today. One primary research goal was to gather information concerning the major aspects of becoming computer literate as an adult. The other was to present these findings in a functional handbook for wide distribution.

Organization:

This first section focuses on understanding the importance of computer education for adults, and the nature of the research that gave rise to the handbook. Of course, the review of the current status of computer education for typical adults, and why this crucial group still needs to be addressed as a rightful computer learning population, will also be examined in the first section.

Part two consists of three areas of research and findings. The first of these involves defining basic computer skills for adults. The question of what "computer literacy" means concretely for people between ages 24 and 65 is addressed. The next topic focuses on the educational structure, or how adults actually go about learning basic computer skills. Stages of learning, common teaching models and approaches to learning are all examined. The last part of the second section focuses on what is generally called "individual factors". Established findings concerning the human-computer interface, personality characteristics and learner anxiety associated with computer use are given attention.

The final segment of the handbook, "The Adult Experience and Recommendations", is by far the most important. It begins with a discussion of the findings of the survey portion of the project. Although very basic in design, we believe that this survey is an important contribution to computer education. It certainly is one of the first of its kind. Additional findings concerning learning patterns and needs from the adult education literature are then presented. The handbook ends with three groups of suggestions and recommendations to facilitate the acquisition of basic computer skills for the average adult learner. The first set focuses on research issues, and identifies areas of special promise or need. The next group involves a series of teaching and learning suggestions for both teachers and adult learners. The final recommendations address the needs of educational administrators and policy makers. In addition to general guidelines, we also provide an outline for an organization that is proven to facilitate the acquisition of basic computer skills for other major learning populations.

Background

The handbook is the product of a federally funded research project entitled "Facilitating the Acqusition of Basic Computer Skills for the Older and/or Job Retraining Learner". The original idea behind the project was that it would begin by reviewing what was anticipated to be large body of educational literature on the subject. The next step was to pull out the most effective training methods for teaching computer skills to adults. The final goal was to develop a detailed, step-by-step manual that would meet the needs of average, unsupported adult learners trying to acquire basic computer skills. However, after spending several hundred hours in one of the most sophisticated and up-to-date computer science library systems in the country (CMU), we were forced to re-envision our task. While this manual is one of (if not the) most comprehensive on the subject of providing computer education for adults, no single effort could be called complete at such an early time.

The simple fact of the matter is that the field of computer literacy education and training for adults is so new that researchers and educators are still struggling with establishing the most basic definitions and goals. While considerable work has been done concerning children, secondary, and college students, the kind of detailed psychological research that we expected to find simply does not yet exist for adult learners. Nevertheless, we stood firm in our resolve to produce an up-to-date handbook of information concerning the major computer education needs, issues and practices for the adult learner. We even conducted some original research that is long overdue in this important area. Of course, no product can really expect to be definitive at this early stage. However, we have produced the kind of empirically based, comprehensive "first clear look" that is necessary during the beginning of any new field.

Although such a work must be regarded as provisional, an overview of the existing educational structure, teaching practices and the psychology of learning basic computer skills for adult learners can itself be a very useful tool. For example, this handbook includes an analysis of the major types of skills that constitute computer literacy for adults. We also provide a description of the learning process, teaching formats and the general educational structure involved in acquiring such skills. An examination of the adult learning experience, patterns and needs, including one of the first studies of adults in an actual computer training setting is included as an important contribution to the field. Finally, the handbook concludes with a series of empirically based research, teaching and policy suggestions for both educators and administrators. These are practically oriented recommendations which can significantly increase both the effectiveness and efficiency of adult computer education in America.

The Current Status of Computer Education for Adults

Problems, Issues and the Need for this Project

Preliminary research indicated that there are three major dimensions of computer education in America to consider. First, it is very clear that the existence of the problem of large scale computer training is genuinely appreciated by educators and legislators all over the country. Second, the need for the development of a effective, well supported educational response is very much understood in both the public and private sectors. Third, while considerable progress is underway for the other learner groups, the needs of the average American adult (those millions who are not supported by state, federal, or corporate training assistance) as yet go largely unaddressed. Let us briefly consider these introductory findings in order to contextualize this handbook.

Metaphors of Change

One way to appreciate the magnitude of the social and educational impact of computers on adult life is to consider the kinds of metaphors that are most commmonly used to describe what computers mean for our lives. These metaphors for change can be roughly grouped into three types: the computer as invention, revolution and transformation. Herbert Simon, the Nobel Prize winning psychologist and computer scientist from CMU, best captures its historical significance when he describes the computer as a "one-in-several hundred year invention" (Simon, 1982). This perspective views the computer as having the kind of impact on our society that Gutenberg's press did 400 years ago. The internal combustion engine is another example of such a transforming invention.

Metaphors describing the computer as a "revolutionary" device focus on its social implications. The computer promises to change how we live and relate to each other socially as well as economically

(Naisbitt, 1982). Congressmen Gore refers to this aspect when he suggested that the "computer revolution is going to have an impact equal to the industrial revolution, but compressed in time" (SIGSCE, 1983,p. 3). Finally, even as early as 1972, we were warned that "Man has begun the construction of a world mind that he will eventually neither fully control, nor understand" (Flood, 1982). In other words, it is likely that computers will alter our perceptions of ourselves, and even the nature of the world itself. That time is already upon us (Turkel, 184)!

Computers and the Educational Crisis

One of the few things that most authorities agree upon is that education is the only real key to help citizens cope with the massive social and economic problems associated with computers. In fact, the need for computer education and training is so great that it has already been called "the next crisis in education" (Deringer and Molnar, 1982). There are three reasons why the National Science Foundation takes this position.

> "A computer literate work force is necessary to maintain our national defense and to improve our productivity. At the individual level, computer literacy is needed to participate in a knowledge society. To insure equality of opportunity all our citizens must have access to these skills and tools" (Deringer and Molnar, 1982, p.4).

Whichever metaphor one prefers to use to capture the meaning of the computer for modern life, it has to be said that it's the universal character of the phenomenon that creates a crisis in education. For the computer has made its irreversible way into the foundations of the economic and military structures of the world. The result of these international aspects of computerization is that educating citizens becomes very much tied to the well being of the nation, both now and in the future. Ignoring or neglecting computer educational needs can only be done with great peril in the modern world. Some of the more advanced thinking nations have understood these implications, and have begun to address them with large scale national computer education projects.

Not surprisingly, the first such project occurred some time ago in Japan. A series of some twenty four lectures were presented via television at the rate of one course per week. The courses were "intended for novices, and aimed at giving them a feel for the computer" (Simauti, 1975,). An even larger, more sophisticated national computer education program aimed specifically at adults was launched by the British in 1982. This BBC Literacy Project included government funded television lectures and a low priced personal computer (the Acorn) to be used at home in conjunction with the course. The project even included training teachers to stand by at local educational facilities to answer questions, and to help with lessons.

Two of the more impressive aspects of the British project are especially important for our purposes. First, it was designed to meet the needs of an extremely large, diverse audience of average adult citizens. Second, it did so at a very low cost per learner rate, and therefore has become the model for similar but smaller scale programs now occurring in a number of countries, including the United States. Since there are several national security issues involved with computerization, a comment concerning the Soviet position on computer education is in order. Anatoly Alexandrov, President of the Soviet Academy of Science, is reported to have said,

> "We are now failing to make sufficiently effective use of even the comparatively small amount of computer equipment that is being manufactured here for industry and for all kinds of planning, design and even scientific organizations.
>
> A broad network of skill-raising educational institutions must be set up... We must develop work like that which was done to eliminate illiteracy after the October Revolution, which is now probably equally important" (Daniloff, 1984 p. 37).

Daniloff goes on to indicate that the task of computer educating the Russians is formidable at best. Fears of security leaks, bureaucratic roadblocks, negative teacher attitudes, administrative conservatism and fiscal problems are cited as chief obstacles. It appears that mass computer education for the Soviets is in the fantasy stage. Without a doubt, the Japanese present much greater competition for creating a computer literate society.

The American Situation

Special Issues

We have already seen that it is possible to create a well coordinated, effective national computer education program for adult learners. There are at least three reasons that America does not yet have a coherent national plan for computer education. First, most countries place the responsibility for education in the hands of their central governments. However, local control is an important value in the American educational system, which means that states and individual districts have a large voice in educational planning and quality control. The Federal system may target and fund priorities during a crisis period such as during the one that arose in response to Sputnick I. However, even then such programs move slowly, and may vary considerably from state to state.

Another reason that we have not launched the huge public education projects that the British have is probably related to our free enterprise system. Some estimates suggest that almost half of adult computer education, especially training, is done by the private sector (Training, Vol 20, No 10). Similarly, it is difficult to force standardization in a free enterprise situation. For instance, we cannot simply designate one computer as "the standard", and then build an educational system around it as the British have done.

The third obstacle to the development of a national computer educational project or program involves size and cultural diversity. Smaller, highly centralized or homogenous systems are relatively easy to coordinate by comparison. For instance, one advantage that the Japanese have is the presence of a very homogenous culture. While the British do have a rich social diversity, they are situated in a very small geographic region. Trying to coordinate a single educational activity for 235 million people with a multiplicity of cultural, educational, and economic backgrounds spread over some 3000 miles is a gigantic task. Therefore, the failure to develop a comprehensive national computer educational policy for adults is easy to understand given these circumstances. Such a policy may never arise for the same reasons. However, just because our educational needs differ at least in terms of scale and complexity, it does not mean that we have done nothing. Indeed, there are some very powerful ideas afloat on the American computer education scene that have considerable potential.

Current American Trends

One of the most important attempts at dealing with the problem of computer education in America are the Hearings on Computers and Education. These hearings were conducted by the Subcommittee on Investigations and Oversight, Committee on Science and Technology, U.S. House of Representatives in September of 1983. Chaired by Congressman Gore, they included both written presentations and oral responses from a number of important educators involved in computer related educational activities. Secretary of Education,T. H. Bell, National Science Foundation Director,Dr. E. Knapp, and speakers for The National Education Association were among the presenters. One of the most important aspects of this exciting meeting was the identification of several key issues concerning computer education. We examined the 600 page transcript of these hearings, and found that many of these issues also impact on obtaining computer skills for adult learners. Let us consider those which are most important.

1. Computer education and literacy are definitely related to job

preparation and security for all populations. For instance, Joe B. Wyatt, Chancelor of Vanderbilt University reported that,

> "For the foreseeable future, it is estimated that the demand for computer science graduates will exceed the supply by 50,000 annually... Other data also show that in virtually all fields of study, the computer literate job applicant has the advantage in the competition for jobs. This phenomenon is also clear for people in the job market without college degrees or without high school diplomas ... a much larger number" (Hearings, p. 70).

2. Software, and not hardware, is a major problem in providing adequate computer related education. Secretary Bell suggests that we are "hardware wealthy and software poor" (Hearings, p. 24). Also, Dr. Braun, Professor of Computer Science, and Director of the Academic Computing Laboratory at the New York Institute of Technology indicates that "the percentage of high quality materials from among all the educational materials that exist has been estimated to be 3 or 4 percent of all which exists" (Hearings, p. 88). The result of this problem is that the development of adequate educational software has become a genuine bottle neck in the area of computer education. The publishing industry devotes an even smaller portion of its resources to the educational computing needs of adults.

3. Teacher training is a problem. Virtually every major educator identified teacher training as one of the most critical problems for providing computer education in America. One analogy to describe this

shortage that seems especially effective in capturing the problem of the quality and quantity of computer teachers was proposed by Chancellor Wyatt mentioned earlier.

> "I would say a "yukkie" analogy would be you take somebody who has never seen, heard, or knows anything about French, you give him a two week crash course, send him to Montreal for a weekend, bring him back, and expect him to train people well enough to go to participate in labor negotiations in French in southern France" (Hearnings, p. 76).

4. The standards for the entire field of computer education, teacher training, and computer literacy are a confusing hodgepodge of ideas, values and positions at best, and an utter mess at worst. Dr. Donald E. Anderson, Chairman of the Association for Computing Machinery, Special Interest Group for Computer Uses in Education, reporting on one of the most authoritative studies in the field states,

> "The first issue is the computer literacy cirriculum chaos. Computer literacy has become a household word meaning the ability to communicate with computers, but widely deverse viewpoints exist on what it means to communicate with computers" (Hearings, p. 345).

The need for standardization and related problems concerning training certification is a major issue in a world where computer credentials are rapidly becoming an economic survival tool. Our survey shows that this issue is epecially important for adults.

5. There is a growing problem of equity in computer education. Dr. Anderson also discusses the issues of equality in computer education at the levels of primary and secondary education in America. He cites a study prepared by the ACM which probably provides the best statistical documentation of computer education trends to date. Of course, we are interested in these findings because they also apply to adults.

Rural vs Urban Differences: The study indicates that students in rural areas have less access to computers than those in cities and surburban areas. Simply put, there are fewer computers in rural schools than there are in cities and suburbs. Fewer computers means less hands-on time per student. Additionally, an analysis of student learning patterns suggests that student attitudes toward computers vary between rural and urban settings. Even when computer time was available, rural students were found to use it less often than the other groups.

Geographic Inequity: It apprears that students living in the South tend to have far less access to computers than those in other parts of the country, particularly those in the West. This problem is related to the previous one, but is intensified by underlying ecomonic and social factors that impact negatively on the South, and positively on the West. The same trends seem to be true for adults.

Gender Differences and Potential Inequity: One major study indicates that males tend to enroll in computer courses more often then females. The suggestion is that there may be a kind of "sexism" effect in computer education that may put women at a disadvantage, especially in terms of their secondary educations. The idea that computer activities are somehow more "masculine" may be a problem associated with the acquisition of quantitative skills in general (Tobias, 1978). Considerable popular literature suggests that the aggressive character of many computer games tends to create a masculine bias in computer activity. However, while this trend may exist for adults, we did not find it active in our survey.

Socio-economic Inequity: Wealthier schools and districts are more likely to have more microcomputers and better computer facilities than poorer schools. Similarly, smaller communities are likely to have fewer computers and facilities than larger communities (but not always). Also, the level and type of economic activity in a particular area is related to its degree of computer sophistication. For instance, one study shows that the Washington D.C. area has more computers than any other part of the country (Sanders, 1982). At the same time, other parts of the nation, such as Appalachia lag far behind. The result is the likely development of yet another social or economic inequity.

In short, if situational, geographic, and economic factors are creating equity problems in computer education for the reasonably well funded and regulated primary and secondary levels, then we can comfortably assume that the situation is worse for adults. If these and other equity problems are not addressed, then the computer will help create a technological underclass, instead of helping to improve life in America.

Other Problems For Adults

Adults face additional obstacles which must be identified. For instance, it is very important to realize that the orientation of the Hearings themselves reflect one more crucial trend in computer education. Most research, educational and funding support is steadily geared toward the younger learner. This emphasis is not without a sound basis. Computer education for the young is going to become an increasingly important problem which requires constant attention. Yet, it remains that the lack of such large scale support for adult learners (especially the average adult who does not qualify for special training programs) is to be found throughout the literature on computer education. It may be unfair to call this focus a bias against adults. After all, Congressman Gore stated the case for adults quite clearly. Nevertheless, this lower level of awareness does constitute one of the greatest obstacles to adult computer education.

Of course, every learner population has its own unique set of characteristics and problems. The high cost of obtaining computer training, the lack of needed financial assistance, time limitations, family pressures and other common adult learning problems are all important considerations. Cost problems associated with purchasing good quality word processing, database management, spreadsheets and other applications software increase the cost of meaningful adult computer training beyond the budgets of many schools. Finally, there are a number of factors that impact on the learning rates and patterns of adults which are not active for other populations.

Current Trends and Progress

While the American situation is markedly different from other nations, we have been very busy addressing this educational crisis in a number of important, innovative ways. For instance, the needs and learning patterns of children are being addressed by educators, researchers and software manufacturers. Educational programs like LOGO, the research work of the Bank Street Group at New York University and even some computer companies such as Radio Shack's Walt Disney series are all concerned with this established market.

The area of secondary education is beginning to receive excellent attention. The shining example of this aspect of the American computer educational scene is the Minnesota Educational Computing Consortium (MECC). This innovative organization has researched the needs of high school computer learners and developed teaching packages which include specific learning goals and detailed lesson planning materials. The MECC also created the first-state wide model computer education program which has probably become the defacto standard in the country. While we do not have a national system, several states have done an outstanding job of beginning to meet the needs of American youth. Minnesota, Oregon, Florida, California are only a few of the states that lead this effort. While our system of local control may have its problems, it has also led to the development of some very fine model programs. The Houston public school system mentioned in the Hearings (page 522) is one. Of course, there is still a long way to go. For instance, a report done by Quality Education Data, Inc. indicates that while Minnesota has some 63 students per computer, Hawaii has 1,072 per machine (QED, 1984)! However, all signs suggest that the trend toward improvement is likely to continue if not accelerate.

There also seems to be plenty of activity concerning computer education at the college level. For instance, the Educational Testing Service has recently included testing basic computer skills in its college entrance examinations. One of the most important aspects of this development is that they selected one language (Pascal) to become their standard. Although it is not without controversy, this decision marks the beginning of basic computer educational standards. Since computers have their historical roots in the academic world, it is not surprising to find a fairly high degree of organization for computer education at this level. One of the most exciting programs is called EDUCOM. This impressive organization is concerned with facilitating the development of computer literacy and education at colleges and universities across the country. EDUCOM has now come to include several functions. Among them are a large scale computer literacy information gathering project, a regular newsletter, and a college oriented computer bulletin board service run on a graduated, fee-for-service basis. The group also sponsors original research on computer education in and on the academic sector (Gilbert, 1984).

Another organization that has been even very active in the academic setting is the Association of Computing Machinery. Simply known as ACM, this professional organization is probably the leading computer information gathering body in the world. ACM has been activily concerned with standards for computer education since the sixties, and now includes divisions which focus on almost every aspect of the computer field. However, by and large, the organization tends to focus more on the sophisticated needs of computer professionals than most other groups. Nevertheless, any report on the status of computer education would be incomplete without crediting this parental organization, especially since it supports many computer conferences. For instance, ACM helps sponsor the annual National Educational Computing Conferences, where a progress report of this project was delivered. AFIPS and IFIPS, perform the same kind of functions, but often at the international level.

When we turn to examine major or national programs for regular adult learners, however, we find a very different situation. The search for educational programs of equivalent research, funding and organizational support was sadly disappointing. One effective way of summarizing the current status of computer education for average adults is to say that the field resembles the very early days of the other major groups. We were able to identify some very interesting adult learning projects. For instance, there are a number of very good private sector activities. Company sponsored adult computer training programs for blue collar workers are beginning to occur. The Seybold Report (1984) provides and excellent review of vender oriented private sector approaches. Finally, Training magazine indicates that over 40% of companies with over 50 employees offer computer literacy or basic computer skills training to their employees (Vol 20, No 10). Unfortunately, however, such programs are expensive to operate and are not usually accessible to the general public.

Another promising trend must be mentioned. There are a growing number of projects that do focus on adult needs. Some of them are very modest and only provide informal computer instruction. Public access computers placed in such locations as a library (Morse, 1984) or museum are becoming increasingly common. There are several larger projects that provide a general introduction to computers via television. At least three such programs were identified in New York, California and Pennsylvania (Pittsburgh). These programs are usually modeled after the British experience, but on a much smaller, more informal scale. By far the most advanced and promising large, full scale community oriented adult computer education project that we uncovered is situated in Ohio.

In 1983 Ohio State University and the Columbus, Ohio public school system, launched Summer Tech '83. This program consisted of a nunber of computer education and training workshops which were designed for the public by OSU. The workshops included two week training courses aimed at teaching basic computer literacy, introductory programming, and all kinds of practical computer applications such as word processing, data base management, spreadsheets, and the like. Many topics were broken into introductory, intermediate and advanced level courses, which were spread throughout the summer. The school system allowed the project to include its teachers, who were specially trained by the University, as well as the use of public school facilities for the classes. Private sector contributions helped make it possible to offer these courses at an average rate of only $20 per person! Over ten thousand people from all over the city are reported to have participated in Summer Tech '83 (Damaria, 1984). Even more were expected for Summer Tech'84. This program involved a massive degree of cooperation between the academic, public and private sectors that could become a national model for mass computer education. The approach seems to maximize the best aspects of the American situation. At the same time, its design also minimizes the problems that our system faces, which were mentioned earlier. We will return to this model in the recommendations section.

The same general state of affairs that characterizes the educational scene is found in the legislative arena. While a national computer education policy has yet to emerge, there have been several proposed bills that indicate a growing national concern. Dan Watt (1984) has spent considerable time watching legislative developments for "Popular Computing" magazine. He identifies at least six major pieces of legislation currently in progress. The list is not exhaustive, and we will not duplicate it here because newer acts and revisions are already being proposed. However, it is clear that these bills can be categorized according to three types. There are those that favor the training of computer teachers as the best approach to meeting our computer education and training needs. Others support hardware accessability as the answer. The third group sees the cooperation of the public and private sectors in the development of quality educational software as the key. Each approach has its own strengths and weaknesses, and therefore must be regarded as necessary parts of the solution. Once again, however, it is important to realize that the legislative concerns suffer the same tendency that the rest of field has been seen to do. This handook aims at increasing public and legislative awareness of the plight of the adult learner.

Summary

The first section of the manual has aimed at identifying the major educational issues, needs and problems effecting the acquisition of basic computer skills for so called "average" or "typical" adult learners. This effort has included a review of the current status of computer education in America. The findings suggest that there is good reason to be hopeful about the future for at least for some of the major learner populations. For instance, there does seem to be a real awareness concerning the importance of the crisis of computer education. Additionally, Congress does seem to recognize that action is needed at the federal as well as state levels. However, it was also found that the area is so new that computer education for the average adult is just beginning to be considered. Consequently, there is a real need for a reasonably comprehensive, empirically based "first clear look", which this handbook provides. The next section concerns a more detailed examination of the educational and psychological factors involved in acquiring basic computer skills for adults. This "nitty gritty" and more technical work also includes original research which results in the teaching and learning suggestions of the final section.

SECTION TWO: THE GENERAL STRUCTURE OF COMPUTER EDUCATION FOR ADULTS

Methodological Issues in Computer Education Research

Finding Acceptable Methods

Any investigation of the acquisition of computer skills for older learners must deal with three basic problems. Two of these issues stem from the nature of computers themselves. First, having been on the scene for only some 45 years (Sanders, 1984) computers are incredibly new as inventions go. Not surprisingly, the important teaching and learning issues are only beginning to be identified. Second, the word "computer" is almost synonymous with "speed". Each new generation of computers, each new major development means huge reductions of time, cost, and a continual increase in application potential. Sanders suggests, for instance, that if technological improvements had developed for automobiles at the rate that has characterized computers, we "would be able to buy a self-steering car for $20 that could attain speeds up to 500 miles per hour and could travel the entire length of California on 1 gallon of gas" (p. 88, 1983)! The result of the relationship between computers and speed is that our world moves faster and, hopefully, more efficiently. Unfortunately, it is also true that the field moves so fast that by the time something is researched and published, significant new information has already been discovered. Finally, the acquisition of computer skills is a highly complex type of human activity that is very difficult to study understand. Many of the particular learning activities involved are cognitive and experiential rather than merely behavorial. However, such phenomena are not well suited to laboratory study, which is the preferred method in American psychology.

A review of human factors psychology and computer education literature reveals that three kinds of methods are used most often when researching the human-computer interface (Weinberg, 1971; Spinger-Verlag, 1983). These methods are description, surveying, and experimentation. Generally speaking, descriptive methods tend to be used in the early phases, especially when a subject's experience is important. Surveys are used when larger groups are of interest, or when the generality of results is important. Experimental methods are used when the researcher is fortunate enough to have the opportunity to study very specific, discrete forms of behavior which can be measured in the laboratory situation. All three techniques must be regarded as reasonably well established, fairly reliable and thoroughly acceptable for researching the human side of computer activity.

A General Structure

Our main research goal concerns understanding the general structure of the learning process involved in acquiring basic computer skills for American adults. Of course, a general structure is composed of two parts: the basic characteristics of a phenomenon, or that which is necessary to its essential nature; and the relationship between these parts (Giorgi, 1975). Determining the general form of a phenemenon is especially important for developing a clear first look, because it provides a framework for knowledge. The three fundamental components of this general structure include: What is learned (computer literacy); how its learned (computer education); and who is learning (the adult learner). The first objective concerns understanding the learning levels, or what kinds of tasks, activities and goals are most important in acquiring computer skill. The second area involves understanding the teaching context, or the educational aspect of the process. The third research activity aims at describing the adult's experience of learning to operate a computer, or the individual factors that are involved. Once these major components have been described, then we can focus on understanding how they relate to one another. The same procedure is used to present the findings for each of the three sections. We will simply identify the topic, indicate what method was used and then present the findings.

Computer Literacy for Adults: What is it

Although computer education is a new topic, the one issue that has received extensive attention is the problem of defining the most basic level of computer skill, or "computer literacy". Establishing solid definitions is an important activity for a new discipline because it creates a foundation for research, and dialogue. Consequently, the first research issue concerned identifying what "computer literacy" means for adults, and how it's structured for the learner.

Method

A standard review of the literature indicated that defining this basic level of skill has itself become a significant problem. For instance, there are those well known figures in computer education

(Luehrmann, 1981) who argue that computer literacy must include the ability to do programming. Others take a more liberal view, suggesting that the ability to appreciate computers constitutes a basic but real degree of literacy (Anderson, 1980). Still another group speak about "domains" of literacy (Lockheed, 1983). The most recent school feels that it may not be possible to arrive at a universal deffinition, and that its time to focus more on particular skills (Gilbert, 1984).

Obviously, if computer literacy has not yet been defined for other groups then the situation must be even more ambiguous for adults. However, it is important to establish some kind of empirically based operational definition so that we can at least be clear in relation to adult literacy. Except for computer professionals, the state-of-the-art concerning defining computer literacy is still very rudimentary. Mainly, it still consists of articles and positions based on an author's own computer background and experience of teaching people to use computers. Since the reality of the situation is that it's still very qualitative, it was necessary to use a method that could begin by considering the articles themselves as data. The descriptive or "phenomenological" approach is one of the established methods for this initial task.

The data pool consisted of some fifty articles which were selected on the basis of the author's credibility, and clarity of opinion. Next, the articles were examined individually for empirical regularities. Those that seemed to have the same perspective concerning what kinds of skills were necessary to achieve "computer literacy" were taken to represent an observable trend, and grouped together. In this sense our activity resembled a form of "content analysis". However, the next step involved analyzing these groups in terms of their underlying similarity. Three kinds of findings resulted from this activity. They include: general findings; the identification of the major types of computer literacy and their learning activities; and an integrated description of the relationship between the major components of learning to use a computer, or the "general structure" of computer education for adults.

Preliminary Findings: Computer literacy in general

1. Computer literacy is a generic term. First, each school of thought has a valid point of view. The kinds of abilities that are required to be "computer literate" seem to depend in large part upon the context of their use. For example, computer literacy for professional programmers requires a very different degree of skill to be literate than do psychologists. The latter's needs differ from those of an office worker, etc. The way that the computer is used certainly appears to have something to do with what is required in order to be considered "literate".

2. Different learner populations have different computer education needs. Children seem to need to "play" with computers in order to use them, as play is a large part of how they acquire information about their world (Papert, 1980). High schoolers have a need for more exposure to computer concepts like basic programming because broad conceptual knowledge can transfer to more potential job situations than does one specialized skill.

3. However, computer literacy does have some internal coherence as a term. There is a unity to computer concepts and activities which make computer literacy a distinct type of human phenomenon. While level and type of skill may vary, computer theory, applications, and use all involve a reasonably consistant and identifiable set of basic concepts, activities, and skills.

4. The kinds of computer literacy requirements that are relevant to the older learners are not well represented in the literature.

Types of Adult Computer Literacy

The second step in describing computer literacy for adults involved researching the kinds of computer skills that adults tend to seek as a group. Information concerning what is required to learn each of these basic computer skills was also desired. The results include the identification of the four basic types of computer literacy or skill. It also seems that there are three primary aspects of the learning structure for all of the types.

The first dimension of becoming computer literate concerns the "world" of the learner, or how one is oriented toward the computer while actually in the learning situation. Next, each type of literacy involves a specific set of major learning tasks and activities. Mastering these learning objectives leads to the acquisition of a particular kind of computer skill. Third, the person's experience of learning tends to vary according to the type of computer skill that he or she is mastering, as each major group of skills has its own character and priorities.

The results consist of a reasonably clear, usefully brief account of the learning structure that older learners navigate in acquiring computer skills (Figure I). This description is designed so that it can be expanded to include more detail as knowledge increases with later work. It should also be mentioned that these types were condensed to short definitions, and presented to adult and college students in survey forum. The findings indicate that these types of literacy do indeed exist. The learners were able to use them to express their preferences as to what they regard as important in their own computer training. We will return to the practical implications of this information in other sections. One word of caution concerning the names of each type of literacy is necessary. While we have attempted to use terms that average learners can use comfortably, every expert wishes to see his or her pet names become established vocabulary. We are not concerned with this activity. Rather, it is the information that the term tries to capture that is important. Although better names may exist for any one of the catagories, the content remains the same.

Pre-literacy

Since computer literacy is an acquired skill, all learners must begin in a state of pre-literacy. While this condition cannot be considered to be a form of computer literacy, it is of a specific character and does occupy an important place in the learning process. Adults live the universal starting point of the "first encounter" in many different ways. Using the computer at the bank, recieving a utility bill, reading about computers, or even seeing them on television are all modes of computer encounter that adults typically experience in everyday life. Generally speaking, this world of "naive" encounter is a little like being in a foreign country. One tends to stumble about, making many mistakes and doing so with a constant feeling of awkwardness. However, the really important kind of naive encounter occurs when the 'meaning' of computerization actually touches one's own life for the first time. The older learner often experiences this moment when the computer comes to the work place, either as a new tool to be mastered or as a threat of displacement.

Two major learner activities are associated with pre-literacy. First, the learner must decide whether the computer creates a need for learning in his or her life. The question of what will the computer mean for me becomes important. Second, if the decision is to learn, then the prospective learner must select some kind of learning setting that is compatible with one's economic and personal situation. In the teaching section we shall see that selecting a learning situation that is suited to an adult's needs is more difficult than meets the eye.

Finally, the learner's personal experience or one's "emotional" response to pre-literacy is important. The basic emotional issue has to do with problems related to anxiety. Particular feelings may range all the way from a severe fear of computers (technophobia), to genuine curiosity. Educational background, occupation, social status and personality are among the main determinants of the individual's initial personal reaction to the computer. Although some people may want to dismiss anxiety as an extraneous matter, we will see that anxiety is a natural part of learning to use a computer for adults in at least one of three ways.

Computer Appreciation

Usually referred to as either computer appreciation, computer awareness or computer consciousness, this first form of computer literacy is most often associated with the academic or school setting. The phrases are generally used to mean a basic level of familiarity with the computer, and what it can do. The learner who is acquiring this most basic computer knowledge is situated in the intellectual world of understanding and appreciation. The computer is presented as an object of study much more than an activity to practice. The word "appreciation" is selected over the others only because it better captures the cognitive aspects of developing an informed opinion of the computer, which is the hallmark of this kind of literacy.

The learning tasks involved in developing computer appreciation are also cognitive in nature. Learning basic computer concepts such as hardware components, the definition of a program, memory functions, telecommunications and the like is the most important learning activity. While actual or "hands-on" experience with the computer is usually involved, it is not seen as the focus of the course. For instance, some people feel that it is possible to develop computer appreciation with no exposure to the machine itself! Even when computer time is included, the purpose of the activity is to demonstrate the concepts, or to ground them in experience as a kind of reference point. The other primary learning task involves developing an understanding of the significance of the social impact of the computer. Appreciating the potential benefits and uses of the computer are important learning activities in this regard. Attention is also given to the problems connected with computerization. Job displacement, unemployment and privacy are three major social concerns.

The affective dimension of computer appreciation begins where pre-literacy leaves off. The initial feelings usually involve some form of anxiety. Variations include hesitancy, reluctance, fear or even outright resistance (Oliver, 1982). Even curiosity, which is one of the more benign first reactions, implies a certain caution. However, if the learning tasks are mastered, the individual develops a balanced appreciation of the positive are negative aspects of computerization. The result of these learning activities is the development of a cognitive map or a personal "model" of computers. Computer appreciation gives the learner a sense of some power or control over the computers in one's life. One has the ability to put the machines into their proper place or perspective, which demystifies them. Additional practical advantages include a reduction of the anxiety associated with ignorance or fear and an excellent foundation for further training if desired.

User Awareness

Another basic type of computer literacy can be called "user awareness". Once again, there are other names for this kind of computer skill. They all imply a more practical rather than conceptual orientation to computers. Names like computer "competence" or "skill" are most common. However, evidence suggests that these terms tend to imply higher levels of knowledge, and describe other forms of literacy better. Awareness seems to connotate a more bodily oriented, tactile kind of knowledge that comes with use. This form of literacy is roughly parallel to computer appreciation in terms of degree of difficulty and frequency of acquisition. Both are introductory activities that can either be ends in themselves, or serve as foundations for higher levels of skill.

The major differences between the two concern the focus of learning, and the educational route by which the learning typically occurs. First, where computer appreciation focuses on cognitive learning activities and goals, user awareness stresses practical applications like word processing or spread sheets. Second, computer appreciation usually involves the academic setting. However, the learning path to user awareness often runs toward business or applied environments. In other words, the world of the learner involved in acquiring user awareness is the functional world of practical application.

Although some time may be given to basic concepts or social issues, learning centers primarily on the utility value of the computer. The learning tasks center on the development of the ability to use a computer in a practical way. Two activities are most important here. The first concerns machine familiarity. Obviously, one must first learn how the computer is operated before it can be used to fulfill a function. Such basic hardware operations as "booting up the system" (start up procedures); encountering and mastering the keyboard, and primary information processing functions (input, storage and retrieval routines), are all significant beginning activities.

The other set of tasks involve the user interface, or the interactive aspects of computer use. The development of the perceptual-motor skills that are necessary to operate a computer effectively are crucial. Practice is the important activity. The initial focus is on habit formation, and hands-on time is a requirement rather than an option. However, the real object of learning is to achieve a level of functional independence that is necessary for productive use of the computer. Structured learning activities such as those involved in learning data entry techniques, word processing, spreadsheet analysis and database management are among the advanced goals for user oriented individuals.

Since user awareness focuses on the practical value of computers, much of the learner's experience concerns practice. Accordingly, all the feelings and frustrations involved in acquiring almost any perceptual-motor activity are also a part of the potential user's experience. Since functional learning tends to require more direct learner participation than intellectual activity, learning to use a computer in a productive way tends to bring with it a different kind of satisfaction. Where the pleasure of computer appreciation lies in the acquisition of conceptual knowledge (which is an intellectual kind of pleasure), the user's reward is the more tangible gratification that comes with learning to use a new or valuable tool.

Computer Competence

It is important to realize that computer appreciation and awareness are different, but roughly equivalent forms of computer literacy. While learning goals and routes differ, they are relatively equal in several important ways. The level of difficulty, the amount of time required, and the cost of learning all appear to be fairly similar. Computer competence, however, means a higher level of literacy, and more advanced abilities. To begin with, it is necessary to be able to both appreciate and use computers in order to become competent with them. However, the ability to appreciate or use computers to fufill a function is not sufficient. For competence also means the ability to deal with computers on their own terms, so to speak. This level of skill does require a functional programming knowledege , and requires the learner to enter the world of personal computing.

This class of learner is generally referred to as a computer or programming "novice" (Coombs and Alty, 1981). This type of literacy involves going beyond the little BASIC programming exercises that the others may encounter. There are two learning activities that are especially important in this regard. Both are complex activities, and must be learned somewhat simultanously. The first group tends to resemble the way that we learn a foreign language. So similar is this activity that learning to do programming is often compared to learning French (Hearings). For instance, because the computer is bound by strict rules of logic, the novice must learn about the linguistic structure of programming. Even though higher forms of computer language such BASIC or Pascal only have a few hundred "words", their meanings are very different from simple machine commands. Perttii Jarvinen of Finland (Jarvinen, 1981) describes the process via the following graph.

```
user   !  types  of                           new expressions
growth !  languages                           ---------------
       !                        procedures /
       !                        -----------
       !            sentences /
       !             ---------
       !    words /
       !  --------                          learning curve
       ! /
       !----------------------------------------------------
                          time
```

Computer learning curve: One's degree of computer fluency increases as a function of one's knowledge of computer programming concepts and language.

Precision, order of arrangement and the rules of programming syntax must be all be learned and practiced. For the computer is an unforgiving device, and its language has no room for ambiguity.

However, as difficult as it may be, learning to read or write a language does not mean that the individual is able to speak it. One who is competent with it must be able to use the language to solve problems. Therefore, problem solving is a second form of cognitive activity necessary to achieve competence with a computer. The ability to develop algorithms and debugging (getting the program to work once it is written) are quantitatively oriented cognitive skills which are necessary. Unfortunately, such skills are poorly understood by psychologists and educators (ASERI, 1983; Tobias, 1978). Earlier we saw that the purist school of computer literacy maintains that such programming ability is the minimum requirement for computer literacy. While such a view is not appropriate for the adult, it is clear that many people who consider themselves to be "comfortable" with programming, simply do not possess a real degree of competence.

The experiential aspects of computing tend to give this form of literacy a more personal flavor than the others. After all, writing a good program and solving problems are essentially creative activities. Anyone who programs knows that there is no "right way" to write a program. They are individual productions or creations that do reflect the way one processes information as a particular human being. Additionally, people tend to step into the "computer culture" once they become sufficiently competent. One can now speak the beginnings of a specialized, prestigious language. Enthusiasm for computers often accompanies this level of development. These and other factors often have meaning for one's identity, or one's perception of his or her ability to deal with the environment effectively. Of course, the computer "hacker" or computer "junkie" are extreme, sometimes pathological, meanings of personal computing.

Computer Skill or "Fluency"

So far we have been dealing with forms of computer literacy that are likely to interest the average adult. However, there is another level that involves a very sophisticated skills, highly specialized or "professional" type of literacy. While such advanced ability does not concern our target population, it is useful to complete the classification of computer skills. Very briefly, the world of the computer skilled individual is the world of the expert. Extensive training and long hours of practice are required to achieve this status. Theory and practice become equal partners in knowledge at this level. While some computer competent individuals may peer into this realm, the computer professional makes his or her vocational home there. Minimal training time seems to average 18 months for beginning levels of fluency. The highest or "wizard" status involves years of work.

The learning activities leading to computer fluency require advanced training in the technical structure of computers or programming. This knowledge is usually accompanied by a specialized form of computer certification. Occupational title, rank and degree of training reflect the particular work activity. For instance, computer repair focuses on the machine itself, programming concerns one type of problem solving skill and systems analysis refers to another. Those at the extreme end deal with pure creativity. The experiential aspects of such skill involve mastery rather than competence. The mathematical aesthetics of programming become fully visible at this level of knowledge (Papert, 1980). Of course, there is little doubt that such skill has meaning for one's identity.

The Learning Structure

Figure I indicates that there are four major types of computer literacy, all of which has its own set of skills. We saw that each type involves a unique constellation of three major components: the

THE TYPES OF COMPUTER LITERACY; A DEVELOPMENTAL MODEL

LEARNER STATUS	LEARNER'S WORLD	LEARNING TASKS/ACTIVITIES	LEARNER EXPERIENCE
Pre-Literacy	The "Unchartered World of the Raw Beginner (niave encounter with the computer)	Discovery of Learning Need (selection of learning environment)	Affective Reaction (range - technophobia to excitement)
COMPUTER APPRECIATION	The Cognitive World of "Intellectual Understanding" (the computer as an object)	Cognitive Mapping (basic concepts, understanding of computers)	Forming an Opinion (range - resistance to conviction)
USER AWARENESS	The Functional World of the End User (utility value of the computer)	Structured Interaction (practice at using the computer manuals)	Acquiring a Tool (range - awareness to comfort)
COMPUTER COMPETENCE	The World of Personal Computing (entering the computer culture)	Speaking the Language (basic programming ability)	Making the Computer One's Own (range -novice to programmer)
COMPUTER SKILL/ FLUENCY	The World of the Expert (establishing computer intimacy)	Mastery (computer as means and end)	Becoming Truly Bilingual (range - professional to wizard)

increasing degree of training required

increasing operational familiarity with computers

increasingly personal experience with computers learner's world, tasks and experience. Therefore, we are forced to say that they are discontinuous, or seperate learning activities. This discontinuity is underlined by the fact that each type has different strengths and weaknesses that make them better suited to some learner needs than others. For instance, the high school student would do well to learn basic concepts. They can more readily be transfered to a wider range of job possibilities than single skills like word processing. This situation tends to be reversed for adults, who have more specific needs.

Another indication of discontinuity is that each particular type of computer literacy has its own range of ability. For instance, although two people may both possess computer appreciation, one may have a more extensive knowledge of concepts and issues than the other. User awareness may vary from simple data entry functions like those of an airline reservation clerk, to the ability to use multiple software packages for statistics, graphics etc. Likewise, once a basic (or) functional level of programmming skill is reached, computer competence ranges from writing personal programs to modifying entire packages to meet specific business or professional needs. Of course, those with computer skill vary from the level of service personnel to theoreticians.

Finally, it must be said that each type of computer skill or literacy is a very complex combination of human activity, perception and experience. These findings are reasonably well established at the empirical level. However, additional research like that recommended by Simon and others (ASERI, 1983) is needed to clarify the specific tasks in greater detail. Also, while adult computer literacy is discontinuous (one can select the type that suits his or her needs), the skills are related to one another in an orderly fashion. This relation is discussed in the next section (see Figure II).

The Educational Structure For Computer Learning Adults

The second aspect of the computer learning process involves the teaching or learning pathways to computer skills. It is necessary to understand how older learners acquire computer skills in order to develop practical teaching and learning suggestions to help them. Identifying major teaching models and approaches that are most commonly used with adults, and integrating the educational and learning structures are the particular research aims of this section.

Method

The informal data generating research activities included interviewing five instructors of computer education who had experience teaching both adults and regular or high school students. We were also allowed to observe these teachers while they were instructing these groups. Their educational backgrounds were representative of the full range of teachers who work with older learners. Their combined credentials included a doctorate in math education, a master's in computer science, two bachelor's in education, and one associate degree in computer science. We were also fortunate to observe them in a number of different teaching situations ranging from two half day workshops to full college courses. Finally, the principle researcher enrolled in both a free non-credit workshop, and an intermediate, for-credit college course in programming so as to observe the process first hand.

The formal procedures were similar to those used for determining the nature of computer literacy. We began with a review of relevant literature on teaching children, high school, college and adult learners, with a clear emphasis on the latter. An effort was made to develop a representative sample by including articles from both popular and professional sources. Then some forty-five articles were examined for empirical regularities (frequently occurring educational themes) concerning learning goals, materials, settings and course requirements. Although this sample may seem small, it is not. Computer education is a relatively new educational activity, and this number covers a good deal of ground. Next, the articles were grouped on the basis of similarity, and analysized phenomenologically. We also examined several introductory computer textbooks and the teaching research for the field. Teaching techniques that were reported to be effective were noted. The following results encompass what were identified as the predominant and effective teaching practices used with adult learners at this time. These results are presented in the form of teaching or learning models, which may be operationally defined as a reasonably clear, well organized or integrated educational format used to teach computer skills to older learners. Each model typifies one way that adults come to acquire computer literacy. Each such pathway to learning includes an instructional orientation, educational setting and learning priorities.

The Professional Model:

This model is the oldest, most complete form of computer instruction in the entire field. The professional model may be defined as a comprehensive, long term, theoretically oriented approach that is characterized by a conceptual and programming emphasis. The aim is to enable the learner to attain the highest level of computer literacy. The format was first established in the late 60's and has now come to have a professional status. This kind of computer education is designed to meet the needs of the computer professional, and tends to conform to the professional standards set by ACM.

The professional model can be situated in the academic or technical settings. The academic version usually involves a four year bachelor degree program or beyond. The training variation of the model is most often seen in community colleges and technical schools. The major differences between the two concern the length and intensity of study, and emphasis. The former learning pathway tends to be longer (four or more years) and broader based, with more attention given to theory. The training route tends to include shorter (typically 18 to 24 months) but more intensive learning periods. The focus is much more toward computer applications than theory.

Academic Model

Having been developed in the university setting, academia has always been the first home of the computer and computer education. However, when software was developed to the point where "non-specialists" (Gilbert, 1984) could use the machine to solve problems in their own fields, a new kind of training model emerged (Combs and Alty, 1981). Originally such individuals were usually limited to a small number of computer enthusiasts from non-computer, even non-technical academic departments. However, the advent of the microcomputer created such an explosion in the business and academic settings that a universal cry arose for "computer literacy" (Carnegie Commission on Education, Rockart and Morton, 1975). A second general approach to computer education evolved in order to meet this growing need.

The academic model may be defined as a reasonably well structured, course oriented educational approach to computer science and uses. The model can also be found in two settings. The college situated academic model emphasizes an introduction to basic computer terms, programming concepts, and the social implications of computerization. The other form is the accredited vocational or night school situation. Here the priority is on the acquisition of practical computer skills such as word proecessing, computer repair and the like. The usual time structure for this model is the academic period. While the academic model does not lead to the professional level of the previous format, it does involve some (at least minimal) form of requirements, formal teacher evaluation and certification of education. Passing academic credits or meeting attendance requirements are the most common standards. An advantage of this learning model is that it does result in a "computer credential". Such proof of literacy tends to have more job potential, and may therefore be well worth the time and expense that is usually involved.

Structured Workshop Training.

The third model of computer training can be described as practically oriented, time limited and structured. Flexibility is the chief characteristic of this model. The teaching priorities usually center on some specific computer activity such as becoming familiar with the machine, data entry procedures, introducing word processing, the use of spread sheets, database management, or almost any kind of business oriented application program. While certification is not usually involved, the model can be designed to fit almost any situation. Variations range from large scale employee in-service training to private, individually oriented seminars designed for specific types of adult learning groups like executives (Seybold, 1984).

A practical orientation, flexibility and reasonable cost effectiveness have made the structured workshop extremely popular in private sector computer training (Sebold, 1984). Indeed, it may well be that more computer literate adults acquired their skills through the structured workshop than any other format. Two factors support this view. First, the shortage of computer teachers seen to exist in the secondary and college settings was even more acute in industry. Second, competitive pressures are so great in that area that many companies simply could not afford to wait for a new generation of computer literate workers. The result was the birth of a computer training service industry complete with research and development, training packages, and marketing tactics (Sebold, 1984; Greer and Marcus, 1983). New developments in large scale computer education, such as the Ohio State University program (Summer Tech, 1983) indicate that this model shows considerable promise for public sector applications.

Informal Learning Format.

By definition this approach is oriented toward providing a flexible, non-requirement individually oriented learning environment. Priority is given to creating a non-threatening, supportive and self-paced learning atmosphere that can accommodate a wide range of learning styles and needs. Because it is self-paced, the informal model often relies on the various forms of educational technology that has been adapted to computer training. Instructional techniques such as how-to manuals, cassette recordings, computer assisted instruction, and multi media methods are commonly used. Some of these techniques are surprisingly innovative. For instance, one company places an individual in a "total computer environment" based on the multi media approach of a flight simulator. The intensity of this environmental approach is said to reduce learning time by its developers (Greer and Marcus, 1983).

The greatest advantage of this informal approach is that it can reach large numbers of people at the lowest possible cost per learner. Free introductory courses, computers placed for public access in libraries, community education projects like Computertown (Loop, 1983), television based instruction, the private lessons that are often included in a computer purchase and, of course, self-instruction are all examples of informal learning. The hallmark of the informal approach is that it always emphasizes self-paced learning. As such, the progress and rate of learning are strictly dependent upon the individual learner. Since there are no formal evaluations or requirements, the roles of individual interests, abilities, motivation and learning style are very influential in this setting. As we shall see in the next section, there are both positive and negative aspects of the model to consider.

Universal Teaching Orientation

In addition to learning models, the review of the educational literature and materials also suggested that there is one well established, fairly consistent general approach to teaching introductory computer skills. This method is termed the "modular approach", and is widely emphasized in the major adult learning models. This 'learning block' design did not originate in relation to teaching computer skills: it has been a part of the educational scene for many years. However, it is striking to see that the approach is used so often. Documentation suggesting that this is a "universal" approach to teaching computers is easy to establish. For instance, an examination of the recommended course structure for teaching introductory level computer science for professionals includes a modular design (Jackson, 1976; Lopez, 1974). Many introductory texts that are used for more general academic audiences are organized in terms of learning "units" called "modules" (Sanders, 1983). The modularization of learning also appears to be well suited to the structured workshop environment (Wagner, 1976). In fact, even many self-paced informal learning materials, such as the manual for the several popular computers, are organized according to relatively discrete modules of information and activities.

It is possible to identify at least five major learning "blocks" involved in the acquisition of computer skills. Each module consists of a set of learning goals, tasks and information that concerns a major characteristic of computers. They are: history and general information of computers; basic programming concepts and techniques; applications and software; social implications and problems related to computerization; and programming techniques and computer theory. The advantage of modularizing textbooks, other learning materials and classroom activities is tremendous flexibility. The teacher can view these blocks as separate but related learning steps. This elasticity makes it possible to "customize" teaching to the needs of a particular learner group, situation or environment.

Learning in the professional setting is aimed at achieving a high degree of technical knowledge and skill over a relatively long learning time. Consequently, emphasis is placed on programming, theory and the development problem solving skills. The academic model, however, is often used to address the needs of a wide range of students all the way from math to the humanities. An appreciation of basic concepts, history, and the social modules are often stressed at the introductory levels. More advanced skills are situated in higher level courses. In the business or training situation time is very often tied to money. Modularization allows workshop trainers to focus their energies on the more pragmatic needs of more pragmatically oriented business situated learners. Also, as previously noted, modules can be used to individualize learning in a way that is appropriate to informal learning.

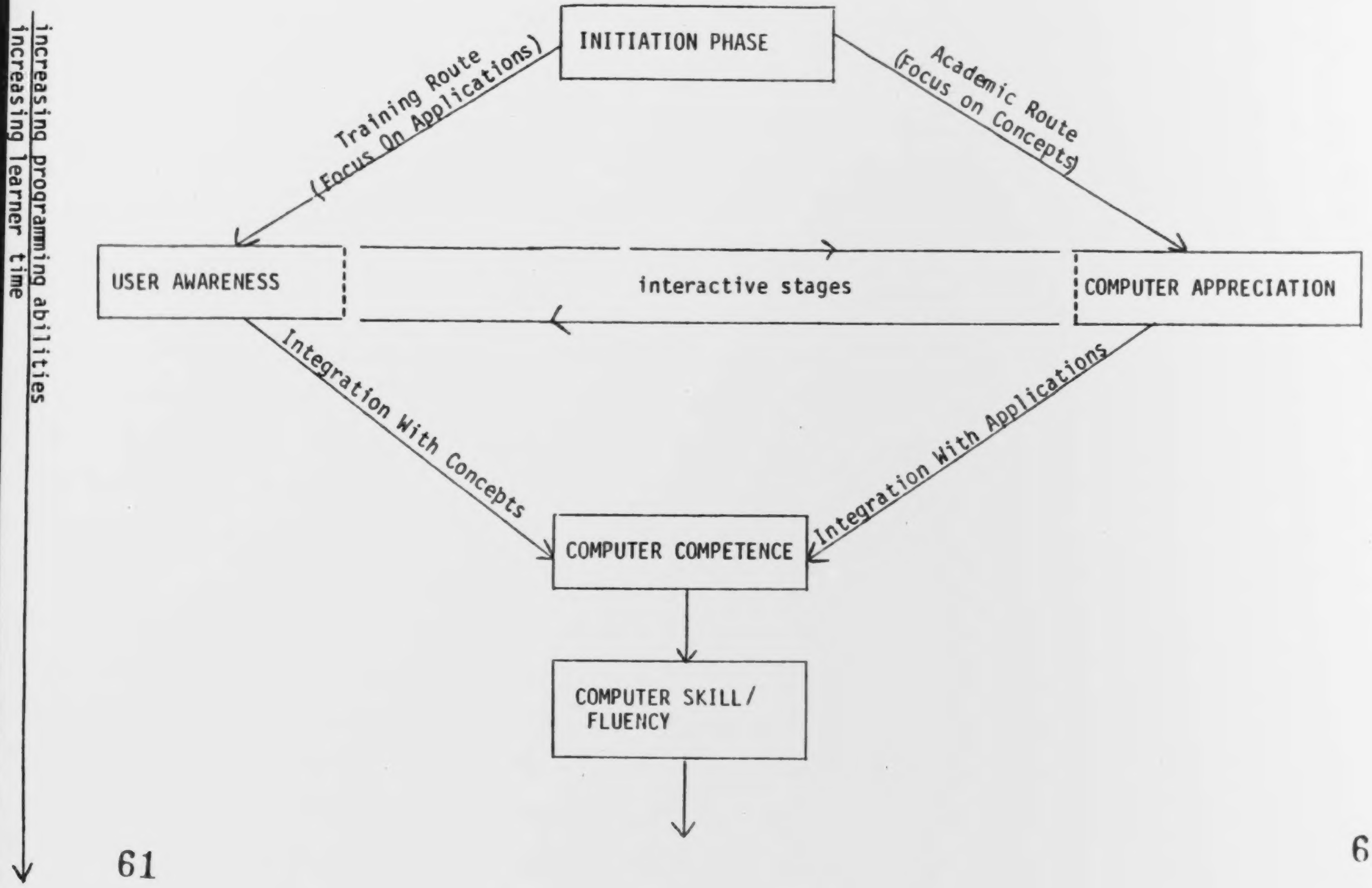
The other advantage of the modular approach is a certain kind educational consistency in a field that is noted for its newness and change. For modularization does not mean that the material contained in one block is not important to the others. They are simply different, but related faces of the same underlying phenomenon: the computer. After all, were this not the case, it would not be possible to talk about a field of "computer science". There are basic concepts and concerns which unify computer science as an academic entity. They also help to form the structure of how computer skills are taught to adults. Consequently, each module invokes the others. Indeed, we shall see that a high degree of computer literacy cannot be achieved without encountering other modules. Thus, the final value of modularization is that although computer skills can be taught to a wide range of learners in very diverse situations, computer education is moderately consistent despite its recent development.

The Educational Structure

Figure I indicated that the learning process we are examining is a discontinuous process. However, Figure II suggests that there is also a progressive or developmental dimension involved. In this chart we see that no matter which of the two major (academic or training) routes the learner takes, he or she can progress from one type of computer literacy to another. Moreover, there is evidence to suggest that the learner progresses in an orderly way. In other words, it appears that the specific types of computer literacy also function as stages of literacy.

DYNAMIC VIEW OF COMPUTER LITERACY

EDUCATIONAL PATHWAYS OF COMPUTER LITERACY


INITIATION PHASE
Training Route
(Focus On Applications)
Academic Route
(Focus on Concepts)
USER AWARENESS
interactive stages
COMPUTER APPRECIATION
Integration With Concepts
Integration With Applications
COMPUTER COMPETENCE
COMPUTER SKILL/
FLUENCY
increasing programming abilities
increasing learner time

The chart illustrates three sources of evidence in this regard. First, computer education involves a sequence of increasingly sophisticated computer concepts, understanding, skills and language. Where each type of computer literacy was found to involve an internal range of ability, we now see that all the types can be placed on a single continuum of literacy. Second, the chart indicates that each type of literacy is connected to the others in a interdependent, progressive way. For instance, we found that in order to reach the level of computer competence, once must first pass through the other two types or stages. Finally, the way teaching and learning time is used in the educational process also suggests that becoming computer literate is a developmental learning process. The more time one invests, the further he or she can move through the structure.

It is comforting to note that there is some recent independent research that supports our findings. Steven Gilbert of EDUCOM (1984) is conducting research on what he calls the "non-specialized" learner. These adult learners work in the academic situation such as social sciences, humanities or administration, but they are not involved in computer science. He has found that these learners progress through a similar type of developmental structure. This classification system starts with the "Pre-beginner", and proceeds to the "Beginner", the "Active Learner-User", and the "Specialist". Of course, Gilbert's work focuses on adults who are professionals in the academic setting, while our work concerns a much broader range of older learners described as "average" or "typical" citizens.

More research is needed to determine how the two groups actually resemble and differ from one another. However, there is an obvious rough correspondence with our findings concerning pre-literacy, computer appreciation, user awareness, computer competence, and computer fluency. The description of this learning process as being both discontinuous (i.e. having relatively distinct types of skills that are learning ends in themselves), and progressive (developmental stages of increasing computer literacy) is fairly well established because of these findings. Even the widely used modular teaching approach reflects both the discrete and sequential character of computer education. Now we must see how such learning is influenced by the indiviual.

The Individual Adult Learner

The Learner Structure

So far we have uncovered the learning and educational aspects of computer training for adults. Only a description of the psychology of the older learner remains to be done. There are several types of learner factors which seem to influence such learning. These include the general learning patterns of adults; individual factors and learning obstacles. Let us consider each in turn.

Adult Learning Patterns

The survey portion of our work examines the actual experience of older learners as they learn to use a computer in a real training situation. However, the advent of the computer certainly did not create the first opportunity for adults to continue their educations. Indeed, there is an entire field of adult education complete with theories, research, specialized degrees of training, and even governmental organizations, such as the National Center for Education Statistics that precede us. Therefore, it is necessary to situate our material in this larger context. At the same time, it is important to realize that the field of "Adult Education" is a large and many headed beast. According to one study, for instance, over 21 million adults age eighteen or more were involved in some form of learning situation in 1981 (Morhman, 1981, p. 1). Technically speaking, the "adult" learner is someone twenty five years or older (Cross, 1981). Even so, the range of individual differences and educational settings is astounding. For instance, adult education ranges all the way from learning to read in a church basement, to advanced continuing education for high level professionals in exotic, vacation-like settings.

Fortunately, there are a number of educators who have done very good work studying the major issues, trends and patterns of the adult learner. For instance, in reviewing the adult education literature Patricia Cross notes that "patterns of participation and interest are remarkably similar from study to study" (Cross, 1978, p. 3). Rather than duplicating existing work, our focus will be on identifying those patterns that seem to impact on adults as they learn computer skills. Our review of the literature, current findings, and survey instrument were all used to guide this activity. For instance, since we are primarily interested in average adult learners, information concerning professionals was left out. Likewise, since employment issues are important priorities we attempted to focus on information concerning job retrainers and women. Finally, since facilitating the acquisition of computer skill is the practical concern, learning patterns, problems and issues which could impinge on this process were included. Using this approach, let us identify what apprears to be the most salient information.

1. Course Selection Adults tend to be pragmatic learners. In 1981 it was estimated that 20.2% of the courses taken were in business, 12.8% in health care, and 12.7% were in engineering and related areas which includes computer training (Morhman, 1982). The sum of these figures (or 45.7%) indicate that nearly half of all adult learning concerns practical, vocational or income oriented instruction. It should also be said that these statistics were compiled before the interest in microcomputers and personal computing became popular.

2. Demographic Factors Income, educational background and location are factors that effect enrollment in adult education activities. For instance, previous education seems to be the greatest predictor of enrollment (Cross, 1978). Those who enter such programs tend to have higher levels of previous educational experience than those who do not. Not surprisingly, money is a factor. Lower income groups tend to enroll much less frequently than do those in upper levels. For instance, the same study reported that while 19% of those enrolled had an income of $50,000 or more, only 6% of the students fell under the $7,500 figure (Morhman, 1982). The same information indicates that working adults tend to be active in educational or training programs than do non-working adults. Geographic differences are also reported to impact on enrollment patterns. In short, demographic factors work together to produce the kinds of equity issues that were seen to be a

problem in computer education in general (Hearings, 1983).

3. Motivational Patterns Numerous studies maintain that many, if not most, adults who enroll in education or training programs do so for employment related reasons (Cross, 1978). "The majority of adults viewed their courses as investments in their careers. They developed skills and knowledge to improve in their current jobs or to advance to new ones, with the hope of earning returns on their investments of time and money in education." (Morhman, 1981, p. 11). This utilitarian orientation also seems to be related to selecting so called "personal development" courses often taken by adults. For instance, many people enroll in adult education do so in order to help deal with the practical problems of major life changes such as divorce, displacement, the death of a spouse, etc. While plenty of older learners do enroll in a computer course for the pleasure of learning, most expect to see a return on their investment of time, money and energy.

4. Learning Obstacles Another area of general agreement concerns the kinds of obstacles that adults encounter most frequently in their educational endeavors. The three major types of learning barriers that Cross identifies seems to be the most comprehensive description (Cross, 1981). Situational barriers are factical conditions that inhibit or discourage learning. Insufficient income, time limitations, transportation problems, handicaps and family related demands (especially child care) are among the most common problems that interfere with adult learning. Institutional barriers can cause adults difficulty. The lack of financial aid for part-time students,

inflexible academic and training class scheduling, and educational requirements that are not related to the primary learning goal are typical instances of institutional difficulties. Finally, there are dispositional factors that are internal obstacles to learning. Negative previous educational experiences in grade or high school, fear of mathematically oriented subjects (computers), low self-esteem and a lack of confidence are all significant in this regard (Kempke, 1981).

5. Educational Support Services There is also a consensus among experts that older learners both need and appreciate accurate, adult oriented career information counseling (Tough, 1978). This learner characteristic reflects the practical orientation mentioned above. Moreover, such basic learner support is especially helpful to individuals who have been out of the educational environment for some time, such as women entering the workplace, job retrainers, and white collar workers in the midst of a career change. Unfortunately, it is often true that those who need such help the most, are least aware of its availability. We shall see that this type of support is greatly needed for many average adults who wish to acquire a computer skill.

7. The Private Sector There is evidence to indicate that the private sector is an extremely important major source of adult education. In fact, "The real growth in adult education in the past twelve years has come in the non-school sector... it appears that business and industry has been a growing source of education and training for adults" (Morhman, 1982, p. 14). This trend is especially true in the area of computer education. As indicated

earlier, industry simply could not wait for the usual sources to fill the training gap caused by the speed of computerization. Corporate programs, professional training services, on-the-job and in-service training all arose to meet this demand. In fact, some estimates suggest that almost half of adult computer education occurs in the private sector. Now one can even find newspaper adds for private computer instruction.

Unfortunately, there are two limitations to private sector sources that effect average adults. The first problem concerns accessibility. Usually, one must be employed by the organization that supports the training. Second, since creating and packaging a good training program takes time and money, such services tend to be expensive. Even obtaining research concerning the private sector can be expensive. For instance, one of the best sources of information on private sector computer training that we could find is the Seybold Report. It is prepared by a private sector firm and made available at $30 a copy! One reason for the high cost is that research and publication are not profit making activities for most professional trainers. When one considers that such up to date information would simply not otherwise be available, such a price does not seem exorbitant. Nevertheless, the typical teacher of adult computer students does not usually have such materials readily at hand.

8. Special Needs Finally, there is evidence to suggest that understanding the learning patterns and needs of special populations is an important part of adult education. For instance, a review of the literature for women indicates that there are specific stumbling

blocks for this group. One study (Markus, 1973) reports that female adult learners rated their most common problem as being less time for children. Less time for husband, neglecting housework, and putting more responsibilities on children and spouses were ranked as two other most frequently occurring difficulties, in that order. Minorites, adults in transition and the handicapped are other populations with special needs. Other special learner needs can also be expected.

Unfortunately, there is very good evidence to indicate that a new kind of adult learner is emerging who brings yet a new set of needs and problems to the educational marketplace. Recent research (Thor, 1982) indicates that the displaced or job retraining person may constitute a unique learning group. Thor defines displaced workers as workers who are unemployed due to plant closures or substantial layoffs, and those who have become unemployed because of economic or industrial changes which have resulted in the loss or reduction of their vocational opportunitites. There are two reasons this population requires our attention. First, our project was located in the Johnstown area. The economy of this region has been based primerily on coal and steel for so long that it is almost without other opportunities. The recession of 1981 created by changing world industrial patterns struck the area with extreme force. Unemployment raged near 25% for an entire year. Many jobs are gone for good, leaving large scale job retraining as the only real economic hope.

The second reason concerns the same problem, but on a much larger scale. While other regions have not suffered as much, these forces have resulted in an unparalleled need for blue collar retraining. In order to address this growing educational need, it is important to realize that this learner has been reported to differ considerably from the other types. For instance, Thor (1982) indicates that they tend to be white, older, less educated, more experienced, and used to higher incomes, than the other major groups. Such factors may act to facilitate attitudes that hamper learning. Another difficulty is that it can be very hard to place such adults. There is some suggestion that even in ecomically troubled areas, potential employers may fear such these individuals will be called back by their original employers unexpectedly, which would mean a loss associated with training and the cost of a replacement for the new employer (Hahn, 1981). Finally, this is some indication that displaced workers may also have a higher incidence of the mental health problems associated with unemployment. For instance, the AFL-CIO claims that the suicide rate for this group is substantially higher than the national average (Thor, 1982). The frequency of family problems is also said to rise.

While these adult learning patterns are not exhaustive, they are the learner characteristics and trends that are most likely to impact on acquiring computer skills. Researchers, teachers of computer skills to adults, and those who make educational funding and policy decisions that impact on adults _must_ be familiar with these issues.

Individual Differences

Although large scale computer education and training for adults is a relatively new phenomenon, considerable work has been done in related areas. The psychology of the user, and the human-computer interface has been a subject of military and industrial interest extending back to the 1960's, which is ancient history in the world of computers (Shackel, 1981; Goos and Hartman, 1983). Computer assisted instruction was a popular idea in the early seventies that is now experiencing a resurgence in the military (Reeves, 1984). When computers burst on to the business scene in a big way during the middle seventies, however, the demand for computer programmers exploded well beyond the existing supply. Starting with Weinberg's classic, The Psychology of Computer Programming in 1971, a flurry of research activity concerning the psychology of computing broke out as academia and industry tried to meet this demand.

Personal Factors

The possibility of a relationship between personality and computer ability was one of the most important questions of that time. One of the more ambitious projects was to create a test that could be used to identify individuals who showed potential for acquiring programming skills. This test, which became known as the Programming Aptitude Test (or PAT), was associated with several people who were involved with the computer giant IBM. This so called "test" became widely used as a screening instrument. However, the very best of the research clearly indicates that this instrument is not a reliable predictor of programming or computer ability (Weinberg, 1971). Most of this personality research focuses on programming and the computer professional. While it is important to exercise some caution in interpreting their significance, there are several promising findings that may effect the average unsupported adult which

which should be mentioned.

1. Certain personality characteristics may be associated with computer related activities or work. Charles Woodruff (1979) did a respectable investigation of personality traits of professional programmers using the Meyers-Briggs Personality Inventory. He found evidence of a constellation of personality characteristics that seems to occur more often with computer professionals. This profile includes such things as preference to do detailed work, the ability to defer gratification, an elevated need for achievement, the preference for control over one's environment, and harmavoidance (the preference for a non-threatening stable environment). Also, another interesting finding is that the test patterns for female programmers tended to resemble those of male programmers much more closely than for general female norms! There is also some indication that extraverted people may not be drawn to the low physical or social stimulation that accompanies computer related acitivity (Eason, 1976). The upshot of these findings is that it may well be that some people are more suited to computer related work by virtue of personality than others.

2. Learning style, or the way that one habitually processes information, may be a factor the effects acquiring computer skills. There are two possible ways that learning style could be active in this process. One way is that certain types of material may be more compatible with specific styles. For instance, someone who is conceptually oriented would probably do better with academic rather than experiential teaching approaches. This possibility is difficult to confirm because of measurement problems. However, there is some

evidence which suggests that making an occupational choice is related to the way that one learns. For instance, Kolb (1976) reports that computer programmers tend to reflect a certain similarity of learning style: a preference for abstract conceptualization.

The assessment of learning style is another one of those areas of educational psychology that is new and needs further verification. However, Kolb's instrument may be especially well suited to the adult learner. The test is simple to administer, easy to score, and is based on experiential and developmental theories of learning, both of which apply to the adult. Our own use of the instrument is reported in the survey portion of the handbook. Our findings do support the view that certain styles of learning impact on computer learning rates for non-technical older learners.

3. Motivation is a (and perhaps the) critical factor in acquiring basic computer skills. Anxiety associated with age or negative previous educational experiences (Cross, 1981), a lack of quantitative ability resulting from deprived or insufficient educational backgrounds (Tobias), resistance to learning because of attitude or previous employment (Cross), and personal temperment or style (Kolb) may all be relevant factors in determining who acquires computer skills, how and to what degree. However, it is extremely important to realize that one point of universal agreement is that there can be no substitute for determination. Like most other learning activities, desire, practice and hard work are the keys to learning all computer skills, even for the gifted.

Computers, Anxiety and Learning

There can be little doubt that anxiety is the most common teaching and learning issue involved in acquiring computer skills, at least for the older learner. Catchy terms like "computer anxiety", "terminal fear", and even the more scientific sounding "technophobia" (Oliver, 1982) abound in the popular press. Many of the "pop" or "how-to" books designed to introduce adults to the computer often spend a large portion of their work on helping the individual overcome computer anxiety. Berner's Overcoming Computer Fear (1984) is an exellent example. Of course, anxiety seems to be especially active as a major stumbling block to computer use for adults. Projects like Logo (Papert, 1982) suggest that children do not suffer the same degree of anxiety as adults do while learning to operate a computer. It may also be that the ability to acquire the perceptual-motor skills necessary in order to use a computer slows down with age. However, a closer examination of the role of anxiety reveals that it is active in three ways that effect adult computer training.

1. Anxiety as alienation First, the introduction of new technology into a culture often creates a problem of alienation. Guetenberg's Press created great controversy as to what might happen when the masses acquired knowledge through books. The Japanese resisted a large scale introduction of the industrial revolution into their society until forced with ships of war. Likewise the automobile, nuclear fission, and now computers are all major technological inventions that bring with them the problems of alienation, fear of displacement, and social upheaval. So frequent is this initial resistance to the introduction of large scale technology into society, that one is forced to accept the reaction as a "normal"

social response. In this sense, people are wise to be wary of new technology, because it will impact on their lives in dramatic, unforeseen ways. This kind of anxiety may well be a healthy and normal psychological response in that it attunes people to the problems and need for change. Thus, one of the first learning issues is helping people realize that an even greater danger is simple or blind resistance to learning something new and perhaps frightening.

2. Anxiety as Mystification The second source of computer anxiety involves the nature of the computer itself. They are not machines in the ordinary sense like autos or airplanes. Computers "speak" an entirely mathematical, symbolic language that mystifies most people. It is now true that one does not have to learn programming to use computers effectively. In fact, we will see that programming is a distant third on most adult computer learning lists. However, the language of computers or "computereese" is so heavily technical and quantitative that it stimulates a real degree of what can be likened to "math anxiety" (Tobias 1978) for most older learners. This kind of anxiety, even extends to the materials that support computer use.

> "One of the biggest and most time-consuming frustrations faced by microcomputer users confronts them when they try to unravel and make sense out of the directions -- the "documentation" -- that accompanies software. Apparently few users are spared: its not at all unusual to read a review that praises a program while damning its documentation" (Earle, 1984).

Such anxiety seems to have its roots in the larger problem of learning quantitatively oriented skills. There is no question that the computer is an unforgiving device. There is very little tolerance for ambiguity in the use of computers, which can be extremely exasperating for most adults. Once the adult oriented teacher makes this realization, he or she can begin to design corrective measures into the teaching format.

3. Anxiety as Fear The third form of anxiety effecting learning to use a computer occurs in most adult learning situations (Kempke, 1981). Simply put, the adult is a more vulnerable learner. Learning situations are more threatening for adults. After all, we are already skilled in the art of survival, and we have managed our own lives so far. Learning a new and complex activity means that we are beginners again. It is pregiven that we will stumble frequently. Embarrassment or the fear of it can be a real problem, especially in the group learning situation. Learner sensitivity or defensiveness are other manifestation of such anxeity.

> Adults have something real to lose in a classroom situation. Self-esteem and ego are on the line when they are asked to risk tyring a new behavior in front of peers (Kempke, 1981, p. 52).

Such performance anxiety is a perenial issue in adult education that is even more common when dealing with computers. For example, the literature frequently mentions the executive who insists that his or her staff become computer literate, but who never quite manages to show up for the training sessions in person. In fact, some of the larger companies recognize this problem to be wide spread enough to offer individual, home, or small seminar teaching environments just for executive staff (Seybold Report, 1984). We shall see that this is one kind of learning problem where educators have made excellent use of the principles of adult education and instructional technology.

The General Structure of Acquiring Computer Skills for Adults

As previously stated, one major research aim was to develop an empirically based description of the general structure of the learning process involved acquiring computer skills for older learners. The learning aspect of this general structure was seen to consist of five relatively discrete types of computer skill or literacy. The learning process was found to be characterized by a progressive structure, complete with stages of learner development and increasingly sophisticated activities. Last but not least, we saw how the adult learner was structured into the process in terms of major learning patterns, individual personality, and anxiety. We can conclude this portion of the manual by integrating all three sets of findings in a single statement of the general structure in which they all participate. Borrowing the basic pattern from the developmental psychology of Merleau-Ponty (1963), we can reach the following conclusion.

For the individual adult learner, computer literacy and computer literacy education is a progressive, yet discontinuous structuration of computer understanding and experience, both of which are organized around an increasingly sophisticated continuum of central computer concepts, uses and language. By articulating both the essential ingredients of the phenomenon and their relationships to one another, this description fulfills the requirements for a general structure. First, the statement includes both the learning and educational dimensions of adult computer literacy depicted in Figures I and II. Next, the role of the individual in the process is implicitly indicated as the crucial determinant in how far one "progresses", or moves along the continuum. Finally, the interaction of all three factors is caputured in the dynamic tone of the phrase.

In addition to unifying the kind of information involved in a "first clear look", this general structure also has practical value. First, this underlying structure has provided the framework for the first real handbook of findings on acquiring computer skills for average adults. Second, this knowledge allows us to make empirically based, timely adult oriented research, teaching and policy recommendations. Now we can finally turn to this most important final task.

PART THREE: ADULT EXPERIENCE AND RECOMMENDATIONS

It was said that computer education for adults has roots in three fields of study: computer science, the psychology of learning, and adult education. Also, almost all computer education authorities caution that the area is so new that all work must be considered provisional, including our own. An additional research complication is that there are several factors particular to adult educational patterns that make their study more difficult. These problems include difficulties in measurement due to the informal and voluntary nature of adult education (Cross, 1978); limited access to information created by the low priority given to research and publication in the private sector; and the lack of computer learning studies on adults. Of course, the information included in the previous findings would allow us to make some general recommendations to help adults.

However, our practical goal of facilitate the acquisition of these skills demands more than global suggestions. We need to identify the teaching and learning issues, needs and practices that specifically effect adults while actually learning to use computers. This kind of concrete information is necessary in order to develop the most effective and efficient recommendations for researchers, educators, administrative policy makers and the informed layperson.

A Study of Adults Acquiring Computer Literacy

Survey Aims

The first area of research focused on what must be learned in order to become computer literate at the adult level. The second was concerned with how learning occurred from the educational perspective. Then we looked at general individual factors that could impact on such learning. The final research activity attempts to develop an empirically based understanding of the actual experience of the older learner as he or she moves through this learning process. The survey method was used for two reasons. First, it is an established method that is used for doing research on the human-computer interface, and for adult education in general. Second, the methods used to investigate the meaning of computer literacy and the learning processs were largely qualitative or "phenomenological". While these methods are well suited for determining the general structure of a phenomenon, (Giorgi, 1975), such findings should also be balanced quantitatively. A survey allowed us to check findings against measureable trends, which increases the credibility of our findings and recommendations.

The only surprising thing is that such a survey has not been conducted before. Indeed, we could only find two other significant surveys concerning computer skills for average adults. The first is a brief survey of the demographic backgrounds in a British study done on a small group of learners in 1983 (Banks, 1983). The other is a larger scale telephone interview concerning the computer backgrounds and interests of adults in the Minneapolis area that was conducted while our research was being done (MCSP, 1984). Neither survey concerns the actual acquisition of computer skills.

Design

Information from the previous literature and findings suggested that there were three design requirements which had to be included in our survey. The first concern was that the sample population had to be reasonably representative of average adults. Since we are interested in facilitating the acquisition of computer skills for a large range of learners, the survey had to be based on a mixed sample of adult backgrounds, abilities, styles and interests. Second, the practical goal of helping typical adults learn basic computer skills for ecomomic and democratic reasons was an important factor. It was necessary to make sure that the study did not survey a large number of professionals or adults who were primarily interested in learning how to use the computer for entertainment or simple personal (home) use. Therefore the learners had to include populations like unemployed, displaced workers, and women. Finally, since the average adult is not usually supported by public or private sector training programs, it was important to survey subjects who were in a typical, rather than such a specialized adult learning situation.

Sample

We were fortunate to have the full cooperation of a number of educational facilities which allowed us to obtain a sample that met all of these requirements. The older learner portion of the sample consisted of three introductory level basic computer courses held in the evening at a vocational-technical school setting. The course structure followed the academic teaching model according to our classification system. While there were no admission criteria, attendance was required in order to obtain a certificate of completion. About fifty-five adult subjects were involved, ranging from age 18 to 64, with the the average age in the mid-thirties. Educational backgrounds varied from high school to a few college degrees. Occupations included service workers, laborers, office workers, technically oriented professionals, sales persons, a libriarian, housewives, and unemployed blue collar workers. The classes were located in a rural setting about half way between Johnstown and Altoona, Pennsylvania. While this region has a very small population of racial minorities, it does have a large number of unemployed and displaced workers. The class also included a large portion of women. Learner motivations varied from personal curiosity to employment requirements, with most people indicating they were interested in the vocational benefit of having a computer skill. In other words, we were able to obtain the desired representative sample.

Methods

In addition to being a new area, time factors limited survey development, resulting in a pilot version. However, there were two ways that we could to strengthen our study. First, information on other learner populations helped in the development of the questions that we asked. Second, we could contextualize our findings concerning adult patterns by comparing them with those of a standard or "control" population. Thus we also administered the survey to a similar number (approximatly 55) of regular college students taking introductory computer science at St. Francis College in Loretto, Pennsylvania. Naturally, there were some significant differences between the courses. For instance, the college students were taking the course for credit and the adults were in a certification format. Likewise their time frameworks varied. However, these course structures are typical for both groups and the number of class hours, and the quality of textbooks and computer equipment were approximately equal. The result was a comparative survey that involved about 110 subjects in five computer education classes, making this study one of the larger ones in the computer literature.

Since we also wanted to follow the progress of the subjects throughout the learning process, there were two parts to the survey. The first segment focused on learner background information and expectations, and was administered during the beginning of the course. The second portion was completed at the end of the course. These questions were designed to generate data concerning learning patterns, positive and negative educational experiences, preferences and needs. Some of the earlier questions were duplicated in the second segment in order to see if the reponses changed over time. Finally, we were also interested in pursuing Kolb's work concerning the possibility of a relationship between learner style and performance. The Kolb Learning Style Inventory was administered to each group half way through the course.

All survey research on adult education must deal with certain difficulties. It was already mentioned that the chief problem concerning sampling and measurement procedures are caused by the informal, voluntary and diverse nature of adult education populations. Since this survey must be regarded as a pilot instrument, the presentation of a full scale statistical analysis was not appropriate. We also felt that languaging the findings in terms of "correlational coefficients" or "product moment correlations" would alienate the communication of the findings to the layperson, who constitutes one of the primary audiences. While basic percentages were used to indicate areas of potential significance, we did try to adhere to as many of the general principles of survey design and interpretation as possible. The representative population, the use of "control" and "experimental" groups, and obtaining a greater that 80% survey participation and return rate all were helpful in establishing fairly reliable first findings. The presentation of results is limited to those questions that yielded significant information.

Findings

The survey resulted in fourteen findings that seem to be especially characteristic of the typical adult learner as he or she acquires a basic level of computer skill. The first five concern similiarities between adults and regular learners. The next eight items describe varying degrees of difference. A final outcome focuses on learning style. The procedure will be to simply present the particular result, and then follow with brief discussion. While the results are provisional, research must begin somewhere, and pilot studies can be an important first step (especially when little else exists)! Both of these considerations should be kept in mind when examining the following findings.

1. Learner Expectations Two findings indicate that adult and regular learner expections of an introductory level computer course are about the same. When asked what they expected to learn in the class at the beginning of the course, both sets of learners indicated

a basic awareness of computers first, and how to use them for work related purposes second. Home use and programming were third and forth, respectively. Likewise, when asked what they felt they had actually learned at the end of the course, both groups said a general appreciation and a basic ability to operate computers. There was also some indication that both learner groups anticipated learning much more about computers than they actually did. For instance, a suspiciously large number of participants seemed to feel that they had acquired a surprisingly high degree of programming ability, more so than is (probably) possible to be acquired via an introductory course!

2. Types of Skills Both learner groups seemed to recognize the four major types of computer literacy that were presented in the section on computer literacy without any difficulty. The subjects were asked to respond to four questions that concerned computer appreciation, user awareness, computer competence, and skill. They were also given a fifth category of "other" to use in case they did not understand or agree with our types. This option was utilized less than 5% of the time indicating some empirical support for the validity of our work on types of computer literacy or skill. Also, most definitions of computer literacy come from computer or educational experts. The fact that these definitions of computer literacy were valid from the learner's perspective suggests that there may be some practical value to their use in course goals, design and orientation.

3. Learning Activities Both groups express a preference for certain learning activities over others. Hands-on time and the practical uses of computers were rated as most desirable. Computer

programming related activities were judged a distant third. Social issues, concepts and history were clearly the least preferred group (module). These findings have some very important implications concerning teaching and learning priorities as they are now practiced. They will be used along with other findings from this study and independent sources to develop a most comprehensive set of recommendations.

4. Computer Anxiety An introductory course seems to reduce computer related anxiety significantly for both groups. Educational research done on college students enrolled in a computer course for the first time suggested that such experience was helpful in reducing their anxiety concerning computerization (Wilson and Trenary 1981; Fritz, 1983). In our study, about 60% of the regular students noted a reduction of anxiety (many of them reported no or little initial anxiety). Nearly 70% of adults reported the same experience. More work is necessary concerning the particular kind of personality and background characteristics important in reducing computer anxiey. However, it does appear that adults do respond positively to computer instruction.

5. Course Format Both regular and adult learners expressed about the same degree of dissatisfaction with the credentialing aspect of their courses. The question asked whether students would prefer the higher computer credential of a letter grade and academc credit, or the less marketable but more relaxed certificate of attendance. About half of the regular learners expressed a wish for the certification format, and 44% of the adults desired the college credit credentialing

format. This finding supports the idea that there is a need for guidance in selecting computer training courses and environments.

6. Study Rate College students tend to study more (but not necessarily harder) than adult learners. The first part of the survey asked both groups how many hours they expected to study for the course per week. They were also asked how many hours they actually did study per week at the end of the course. Regular learners cleary studied more frequently than older learners. They also missed fewer class hours during the semester. The factors that may impact on the rate of study for each group are presented in another finding.

7. Sex Ratios The ratio of men and women students was surprisingly different between the two groups. Men out numbered women by a significant degree for college students (65% men to 35% women). The reverse was true for adult learners (54% women to 46% men). The first finding is fairly typical for college students. However, to find significantly more women than men enrolled in computer education is an important event that needs further exploration. For instance, it is logical to expect that the sex related aspects of the equity issue discussed earlier would mean that fewer women would be learning computer use, especially in a rural area. However, it may also be that sex related factors impact negatively on men. For instance, it may be that the "macho" image that is sometimes associated with being an iron worker or coal miner prevents men from "fussing around" with computers, or creates difficolty for men in terms of the passivity associated with the school setting, or with returning to school.

8. Classroom Hands-on Time Five classes of learners (two of

regular learners, three of adults) were surveyed. It is interesting to note that the adult courses dedicated significantly more time to actually working with the computer. On the average, approximately 50% of the adult learner's time was spent in the computer lab. The college students spent less than 20% of their class time there. While the regular learners were expected to use the lab on their own time, many of the adults did so as well. This finding may reflect the more practical orientation of adult learners previously discussed.

9. Learner Aids There was some indication that adults and regular learners react differently to fairly standard teaching techniques. While both groups found the same general techniques to be helpful, they ranked them in a different order of preference. When college students were asked what was most helpful to them, they reported hands on time, outside practice, the text, discussion with fellow students, and class discussion as the 5 most helpful items, in that order. Hands-on time, the text, class discussion, lectures, and then discussion with other students were rated in decreasing order of helpfulness by adults. It would appear that adults tend to rely on the teacher much more that do average students.

10. Learning Obstacles The order of the factors that interfered with learning to use a computer also differed for the groups. College students ranked personal problems, other school activities, work activites, family related problems and transportation as the five major difficulties outside of the classroom situation. The adults reported personal problems, work responsibilities, family issues, transportation, and then school related activities as most commonly

interfering with their ability to learn or study. These findings correspond with the general literature on adult education. Obviously, the teacher should anticipate such difficulties and try to design the course with them in mind.

11. Learner Support Being somewhat experientially oriented in our research, we were also concerned with what the learner thought might be most helpful in the way of educational support. Once again there was a significant difference in the order of preference. Regular students ranked individualized or small group attention, practice on computers at school, and the low cost use of a home computer as likely to be the three most desirable learner supports. Adults, however, indicated that having low cost access to a computer at home would be most helpful. Individualized attention from the teacher and then practice at the school were rated next. This finding reflects the importance of hands-on experience and will play a significant role in the recommendations for adults.

12. Learner Enjoyment Adult learners seem to enjoy learning to operate a computer more than college students. While 86% of adults said they enjoyed the class "very much", regular learners responded positively to this item only 38% of the time. Two factors are likely to be active here. First, most (but not all) of the adults were taking the course on a voluntary basis, while many of the regular learners were doing so as a requirement for graduation. Second, as we will see in a moment, the meaning of becoming computer literate may be different for the older learner.

13. Self-Esteem One of the most intriguing findings from a

psychological perspective concerns acquiring basic computer skills and self-esteem. Both groups were asked to indicate whether they felt that taking the course increased their self-esteem. Since the question was purely exploratory, the three possible responses ranged from "No", "Maybe" to "Yes" in orientation. College students responded with "No" 21% of the time against only 12% of the adults. Some 54% of the regular students indicated a "maybe" response to 20% for adults. Finally, only 25% of the college students indicated that they experienced an increase in their self-esteem that could be associated with learning to use a computer, compared to a dramatic 69% of the adults!

There are several reasons that may be active in creating such a difference. For example, cognitive dissonance theory would suggest that since adults have less time for learning than their younger counterparts, they may value what they do with it more. Humanistic and developmentally oriented theorists could attribute this finding to the pleasure that is associated with mastering one's environment more effectively. The obvious implication is that teachers must be cognizant of the role of self-esteem in learning to use a computer for adults, or such learning may not occur! Factors which increase self-esteem must be included in one's teaching approach, and practices which lessen self-esteem must be avoided at all costs.

14. Learning Styles As indicated, one final vein of research is the question of whether learner style impacts on the rate of acquiring basic computer skills. Since Kolb's Learning Style Inventory has been used to assess learner style for computer professionals, it was

selected for use as an appropriate exploratory instrument. Very briefly, this test is based on Jungian developmental psychology (Kolb, 1976). The basic idea is that the way one learns is related to the interaction of perception, personality and experience as they develop over time. Of course, it is not possible to go into a detailed discussion of the instrument or its underlying psychology. However, it is important to say that it divides the way people learn into four basic learning styles, or ways of processing information and experience in the learning situation. Kolb has also found that these styles of learning are also associated with occupational choices and activities. Thus the "Accommodator" gravitates to business occupations; the "Converger" is found to prefer concrete detailed technical work; "Divergers" move toward the humanities; and "Assimilators" prefer abstract sciences.

Ideally we would have liked to study a large enough sample to evaluate the possibility of a relationship between learning style and degree of computer skill attained for both adults and regular learners as separate populations. Unfortunately, our sample was too small to provide a large enough number for such a comprehensive analysis. However, we did combine the learning style profiles of those who were rated to have done especially well and especially poor by their teachers in both groups. This procedure resulted in a total of 44 subjects for an examinitation of learning style and performance outcome. We also administered the LSI to 14 computer professionals, including programmers and teachers, in order to provide some sort of control group for normative comparison.

Although the analysis is limited by sample size, there were some interesting indications of possible correlations between learner style and performance, at least for computer skills in the academic model. The most reliable finding seems to be a negative relationship between performance and one particular learning style. Almost 56% of those who were "Divergers" were rated poorly by their teachers. Further, none of the 14 computer professionals demonstrated this learning style. At the same time, divergers made up the second largest learning group for both the adult and regular learners. In other words, there is good reason to suggest that learning to acquire basic computer skills of this type presents special difficulty for one of the largest learner groups in the study. Psychologically speaking, the reasons for this apparent learning problem are probably related to the three types of anxiety associated with computers mentioned before.

Recommendations

This handbook strived to collect, catalog, analyze and increase knowledge about how older learners acquire computer skills in America. To the best of our knowledge, we have developed the single most comprehensive handbook on the subject to date. Of course, more work is needed. However, we cannot escape the fact that this educational crisis for adults is upon us now. Action must be taken in spite of the provisional nature of all early findings. The following recommendations come from three sources: adult education literature; computer science teaching techniques that are reported to be helpful, and our own work. Every effort has been made to base the suggestions on either empirical evidence, or at least independent sources.

The result is a reasonably reliable set of research, teaching and policy recommendations that are designed to facilitate the acquisition of computer skills for the target population. As indicated in the opening section, the handbook is aimed at educators, administrators and the educated layperson. It is expected that it will be necessary to modify the suggestions according to the requirements of actual learning situations, teaching styles, institutional capabilities or individual learner needs. This use of the manual is completely encouraged, providing the underlying principles are fully understood and respected.

Research, and Teaching/Learning Recommendations

Research Needs and Priorities

The description of the general structure is an important research event for two reasons. First, it articulates the fundamental character or psychological "core" of a phenomenon. Second, this statement also provides a framework for the coordination of related information from several converging areas such as computer science education, the psychology of learning, the psychology of the human-computer interface, and adult education. However, further research must be supported. While the general structure prepares the way for a coherent body of knowledge, it is only a beginning. Validation studies and more detailed work are absolutely necessary. Otherwise it is doubtful that we will be able to meet the computer education needs that are required for our society to maintain a competitive position internationally, and to prevent massive social problems at home. Because of the general shortage of research funds, it may be necessary to prioritize certain areas over others. Our research indicates that the following areas should be targeted for further work.

1. Other Adult Populations While most of our descriptive work focused on the typical adult learner in general, the survey was situated in a blue collar rural location characterized by high unemployment. The equity issue in computer education suggests that other older learner populations may have different needs and patterns. For instance, we were surprised to find that women did not rate day care as a learner support of high value. However, it could be that the extended family is stronger in rural areas, providing a ready source of baby sitters. Such a need may be greater for single parents in the urban setting. Also there is some indication that age related factors may play a part in computer education. For instance, what kind of computer skills are most desirable may vary with age. We found that practical skills are of primary interest to working adults. Gilbert's (1984) work substantiates this impression. Yet another study indicates that the elderly (over 65) may prefer to learn simple programming techniques to applications (Furlong, 1984). Such information is necessary in order to design the most effective and efficient kinds of computer training programs, materials and policies.

2. Adult Cognitive and Learning Research There is some indication that the kinds of basic cognitive research called for concerning other learner populations is also needed for adults (ASERI, 1983). For example, learning time may be effected by differences in fluid

versus crystallized intelligence (Cattel, 1963). Second, specific types of computer literacy must be studied in more detail. For instance, it is reported that some 20 to 40 hours of learning are required to master a basic software package (Jones, 1984, p. 59). More detailed research on learning specific kinds of non-programming, non-specialist computer skills like word processing, data entry and the like is necessary to improve documentation, learning time, and ease.

3. Teaching Research is Needed Most of the techniques for teaching adults computer skills come from three sources. They are borrowed from those used to teach computers to other learner groups; they are simply modified versions of general adult education techniques; or they are created spontaneously by individual teachers. However, it may be possible to design more effective teaching stategies by basing them on scientific rather than experiential evidence. The possibility of a relationship between learning style and performance may mean that specialized teaching techniques may be helpful to some people. Also, structured research tends to facilitate the development of recognized, accepted practices and computer teaching credentials which are also greatly lacking in adult computer education as it is now practiced.

Teaching Factors

These research findings can be used to develop two types of teacher oriented suggestions that can facilitate the acquisition of computer skills for adults. The first set concern teaching practices that can enhance the learning environment for adults. The other group focuses on practices that show promise as effective techniques for the development of computer skills. Naturally, these recommendations can be modified to the requirements of the teacher's particular background and specific learning situation.

1. Learning Environment It was said in the section on Individual Factors that motivation was the key to acquiring basic computer skills. This variable was also found to be an independant learning factor that the teacher cannot control. However, we can do something to enhance the possibility of learning. The following four practices are ways that teachers can create an environment which supports mastering skills for older learners.

2. Adult Teaching Orientation As already mentioned, the literature on adult education indicates that older learners are a special learning population. The teacher that appreciates the general characteristics of this group has a tremendous advantage over one who simply transfers teaching style and techniques from the other learner populations to this group. Therefore, it is recommended that teachers of computers skills to adults make themselves available to the body of educational literature and common practices that have been shown to be effective for adults in general. Probably the single most important teacher attitude in this regard is to treat the adult learner with respect. In addition to recognizing the fact that the adult learner has already achieved a degree of competence at life, such an attitude helps the teacher to avoid embarassing moments, learner resistance and other negative learning factors.

3. Non-Threatening Approach Two findings suggest that adults tend to learn about computers more effectively in a non-threatening learning

situation. First, it was found that there is often a very high degree of anxiety associated with computers for many adults. Second, evidence suggested that the older learner tends to be more vulnerable than regular learners. A rigid, authoritarian teaching style can only exacerbate these problems. Also, a non-threatening approach that emphasizes learning, and not performance, is preferable with this group. While some sort of performance evaluation may be required, it is recommended that such activities be kept in a background role. The range of learner backgrounds, abilities, available time, and a host of other factors that affect adults mean that learning is bound to be uneven. The teacher who anticipates such variation is better equipped to deal with it than the one who does not. For such awareness allows the teacher to design flexibility into his or her lesson plans and teaching goals.

4. Practical Class Structure The adult education literature indicated that adults tend to be pragmatically oriented learners (Cross, 1981). They are especially interested in learning activities that can improve their economic or vocational situations. The adults in our survey indicated the same preference. What is surprising, however, is that so much of the learning and teaching material used to instruct adults concerns programming rather than more practical skills. While programming certainly is a desirable computer skill for anyone to possess, the evidence indicates that it is not the most appropriate teaching or learning emphasis for most adults.

There are three reasons for this recommendation. First, computer programming is a very difficult quantitative skill that requires considerable time and work to learn. Simply put, a marketable level of programming skill is not something that is learned through one or two courses. Indeed, we saw that programming was associated with computer competence and fluency which are higher levels of literacy. Second, evidence suggests that adults rate having other kinds of computer skills as more desirable than programming. For example, our survey indicated that user awareness, or the ability to do certain kinds of computer applications such as word processing, were valued more highly by adults. Independent evidence for this position comes from a telephone survey of about 1100 randomly selected adults on potential computer needs (MCSR, 1984). Additionally, there is evidence to suggest that even the highly supported non-specialized academic adult learner is losing interest in learning programming for more practical computer skills (Gilbert, 1984).

Finally, adult learners prefer practice to theory. The fact of the matter is that adults are intelligent learners. They are fully aware of the value of their time, and clearly expect a "return for their investment". It is true that a concepts and programming oriented emphasis is important at the high school and college levels. However, it is time to accept the lead of proprietary (private) teaching in regard to adults. The emphasis for adult computer education should be on helping them to overcome computer anxiety, acquiring machine operation and basic data entry skills and, of course, teaching adults to use standard applications software. While teaching programming may be more noble, it may also reflect an academic bias toward theory. It is important for teachers to remember that there are other valid computer skills, and some of them are more valuable to adults.

Teaching Techniques

Our review of the computer education literature indicated that there is very little published research on teaching techniques developed specifically for teaching computer skills to adults. We have seen that the reasons for this condition include such factors as preoccupation with other learner poplulations; the lack of publishing in the private sector (such techniques would be "trade secrets"); and the presence of an academic bias in the field. However, there are a few well established teaching practices that are commonly used for teaching various other populations which may be adapted to adults. Additionally, our own research suggests that some practices should be especially facilitative for adult learning. Let us consider those which are most promising.

1. Hands-on Experience It will be recalled that both learner groups rated hand-on time as the activity that helped them the most. Learning to use a computer is a complex process because it involves both cognitive and perceptual-motor activities. This complexity is the reason that industry has spent so much time and energy on the development of "user friendly" hardware and software. The Apple MacIntosh and the Hewett-Parkard Touch Screen computers indicate that simplifying the operation of the machine will increase its use by the average person. Nevertheless, there is simply no substitute for actually sitting down and spending time with the computer.

Several good reasons support making hands-on experience an essential activity. First, actually using the computer seems to be the best way to overcome computer fear. The three basic techniques used to introduce the learner to the machine are the computer game; a tutorial disk or tape that takes the learner through the basic machine operating commands; and developing simple programs whose only value is to help the user become familiar with using the machine. All of these proven teaching techniques work. Basically these methods help the learner over come the problems of anxiety associated with computers by focusing on very limited, easy-to-master concrete tasks that build up confidence. At the same time this activity gets the learner to experience the computer as it really is: a labor saving device that aids problem solving, much like an automobile aids transportation.

2. Practice Time Two sources of information suggest that practice time is a corollary to hands-on experience. First, the psychology of learning suggests that the acquisition of computer skills is based on the same fundamental principles that are involved in any kind of complex learning (Card, Newell, Moran, 1983). The development of perceptual-motor skills or problem solving abilities take time. Moreover, habit formation requires experience and repetition or practice. For instance, it was indicated that learning to use one computer application required some 20 to 40 hours of learning, much of which was practice (Jones, 1984). Consequently, the relationship between practice and the degree of skill is the same for computers as for any other learning activity; the more one does it, the better one becomes at it.

Second, our survey found that the adult computer class stressed experience much more than the regular class. Where the adults spent 50% of the class time in the labs at their computers, the regular learners were only given a few hours of instruction in the lab with the teacher, and expected to acquire additional time on their own. We were also surprised to see that adults tended to arrive one half hour early for their computer class, and spent the time by themselves in the lab. Most experienced teachers of adults, especially those who do training, already appreciate the value of hands-on and practice time. New or more academically inclined teachers interested in teaching older learners, would do well to examine this variable more fully.

3. Using Discussion There is good reason to believe that discussion activities of all types can facilitate learning to use a computer for adults. It will be recalled that our survey indicated that adults tended to rely more on the teacher than did regular learners. Class discussion was rated highly as an aid to learning for both groups, as was interacting with peers. We also suggest that building discussion into the teaching format reduces anxiety, especially at the beginning of the instructional period. Sometimes, for instance, a student may feel more comfortable discussing a problem with another student who is "less threatening" than asking the teacher. Also, feedback that the teacher receives through discussion can help him or her to adjust the pace of the course to the needs of a particular group. One form of the discussion technique is to group students into pairs or small groups in a "team" approach to learning (Shniederman, 1982). Selecting advanced students to help others in a "tutorial" format is another way of using discussion to facilitate

learning.

4. Contextualizing the Computer There is good evidence to suggest that helping the student to develop a personal model of how the computer works is helpful to acquiring basic computer skills. Building a model that is based on one's own experience seems to give the learner a frame of reference for computer functions that facilitates learning. Mayer's work on programming compared groups of students who were given such a model (the "white box" approach) with a group who were not (the "black box" approach). Those who were encouraged to develop their own internal model of how a computer works were reported to learn more effectively that those who did not (Mayer, 1982).

Another effective way of contextualizing the computer for adults seems to be through the use of analogy and metaphor. Every one of our teachers reported having favored ways of situating the computer in regular human life that seemed to facilitate the learning of basic computer functions. One instructor likened a computer's operating procedures to the kinds of routines that we have when we wake in the morning. The metaphor was extended to compare how failing to execute a procedure in logic creates difficulties for the computer in the same way that failing to proceed from one routine to the next can throw the entire day off for a person. Another teacher used the familiar file cabinet analogy to explain memory functions. Still another used playing cards to illustrate sort routines. Such techniques all serve to situate the computer in the everday world of human experience in such a way that gives meaning and familiarity to an otherwise alien device.

5. Educational Technology When technology was introduced to the educational scene in the sixties, it was accompanied by all kinds of claims promising a boon to education. The same fanfare occurred with the introduction of educational software in the middle and late seventies. Neither one of these developments came close to such claims, so one must be somewhat skeptical about the use of educational technology. However, there may be some value to a variety of media assisted techniques in acquiring basic computer skills. First, there seems to be considerable investment of time and money from the private sector in the development and promotion of media assistance. For instance, in addition to the standard computer manual, it is now possible to find disks or cassette based tutorials for most major brands of computers, and most major software applications.

Our evaluation of such formats is that they are excellent introductory devices for simple learning functions such as basic computer concepts, exposure to computer hardware and operations, and learner oriented anxiety reduction. More sophisticated media techniques are also on the way. These technologies range from video disks all the way to total "computer environments" already discussed. The most authoritative source on computer and media assisted computer instruction is the Seybod Report. This private sector report documents several interesting projects that are underway in the corporate and for-profit training fields. However, almost all of the more sophisticated projects are still in the developmental or field testing stages. Except in the case of the extremely motivated learner, we must conclude with Twila Slesnick (1984) that at this point, computer assisted instruction seems to provide an advantage only when used in conjunction with regular classroom sessions.

Learner Oriented Suggestions

Our last set of teaching and learning suggestions concern the individual aspects of the adult learner situation. It will be recalled that our findings indicate that there is a real need for learner support for average adults who are attempting to acquire basic computer skills. For the most part, this population receives very little assistance of any kind. If they are working at lower level jobs, for example, they do not usually qualify for federally assisted training programs. If they are single parents, day care is their own (costly) responsibility. The list of learning obstacles is just as foreboding for the average citizen as it is for any older learner. The following suggestions are aimed at supporting the individual efforts of such adult learners.

1. Financial Support Whether we like to admit it or not, money is a major determinant in any educational activity. Whether in the public or private sectors, education involves a considerable investment of financial as well as human resources. This relationship between money and computer education/training is seen most clearly in relation to the range of learning settings. At one end of the continuum, we find the most basic informal learning formats. Poorly funded learning situations usually involve the least sophisticated variations of the informal learning model. Such environments include a public access computer located in the library, a simple home computer or the

situation where one or two computers are shared by many adults. At the other end of the scale, however, we find the most luxurious, adult oriented learning settings such as weekend computer camps set in plush resort settings. It is also possible to find almost ideal, well structured, professionally operated one and two week university based computer camps with the best of learner support and material. These latter kinds of programs run into the hundreds of dollars. In fact, in more sophisticated or urban settings is it not uncommon to find private computer lessons available --- at the rate of some $60 per hour!

In addition to tuition and fees, there are a number of hidden costs for older learners. Day care availability for women with children, transportation, etc. are all costs that increase with the length and degree of computer training. A third problem is that most adults do not qualify for educational loans simply becuase such monies are not usually avalible for part-time students! In other words, unless an adult is willing to go to school full time, or borrow money at outrageously high interest rates, he or she is forced into the less sophisticated computer training situations. Many times these formats do not provide the kind of certification or credentialing that improves employment or career opportunities. The only way of eliminating this equity problem between the haves and have-nots is by making some kind of financial support more readily available.

2. Increasing Computer Access Unfortunately, access to sufficent computer time is another problem that adults face. It has already been shown that learning time (hands-on experience and practice) is

related to how effectively one learns to operate a computer. However, most adult learning situations are such that computer time is limited to the actual course period, plus some pre-class warm up time. This is one of the reasons that the adults indicated that having access to a home computer was their first choice in terms of learner support. The obvious answer to the access problem is to supplement classroom training with home learning. The problem is that using a home computer involves the same financial problems as learning in a decent instructional setting -- money is necessary.

The falling prices of computer hardware and software point to another solution. It is now possible to obtain a reasonably decent, fairly well supported "learning computer" for about $200 (Consumer Reports, 1983). Introductory level word processing, database management, spreadsheet programs and graphics packages are also available for such machines as the Radio Shack Color Computer or Commodore 64 (they are only two examples) are also relatively inexpensive. Additionally, many major computer manufacturers provide substantial discounts to educators. In other words, since it is not yet possible to obtain low interest loans for part-time computer training, or to write off such costs as a tax deduction, then schools must make the initial purchase, and then make such equipment available to students. A returnable deposit and small rental fee can be built into the course structure in a way that both allows adults to use a computer at home, and even in a way that can eventually pay for itself. Of course, the clever grant writer is also welcome to apply to one of the several public and private sector funding sources that would cover the initial costs of such a program! One company even sells a guidebook on writing applications for computer grants.

3. Computer-Career Advise The adult education literature already cited indicated that down-to-earth career counseling is a learner support that is greatly needed, and genuinely appreciated, by adults. When done properly, effective career counseling can help adults in numerous ways such as designing individually oriented training programs; assessing occupational interests and learner ability; and especially guiding adults to selecting courses which are best suited to their long term goals. However, the literature also revealed that many times such services are not available to this population in general. It was also suggested that even when career advise is available, many adults do not know about it.

Our survey suggests that many adults interested in computer training face the same dilemma. Evidence for this claim comes from their responses to two questions. First, the learner expectations indicated very clearly that beginners expect much more from an introductory course that it can possibly provide. Such naiveté suggests that students need some realistic counseling as to what kinds of computer skills are possible, and which are most suitable to their needs, interests, abilities and finances. Second, we found that almost half the adults reported dissatisfaction with the credentialing aspect of their computer courses. Many times it seems to happen that older learners may seek out one kind of training (practically oriented), and end up with another (theoretically oriented). This situation wastes valuable time and money for everyone concerned.

As it now stands, unless one is a part of an academic institution or an organization that provides in-house training, the typical adult is left to his or her own devices in acquiring a basic computer education. At best, this approach is a very inefficient way to learn a marketable degree of skill. For most beginners, it's something like being left alone in a forest without a compass -- at night. In short, the research indicates that older learners would benefit considerably from effective, individualized computer education counseling or advice. There are two ways to meet this need. The first is to use the standard face-to-face academic advising format where the learner meets with a counselor to discuss career goals and learner computer needs. The advantage of such an approach is that it is the best way to develop an individualized learning plan. The disadvantages are that it requires a counselor who is familiar with the structure of computer education, the adult learner, and who is available at a time that is suited to the typical adult's frequent time and financial constraints. Some schools do provide such resources, most fail the adult in one of these crucial ways.

The other approach to effective computer advice is to create a self-assessment instrument that can at least point the adult in the right direction. Such a format should provide a straightforward evaluation of the most relevant factors. This instrument would help facilitate the selection of the most appropriate type of literacy, the level of skill desired, the length of learner time that is likely to be involved, the cost and the most appropriate training setting. People who need data entry skills do not have to suffer through programming lessons. Those who need more advanced skills should not mistakenly invest time and money in a course that is geared toward general computer education. Such an assessment device can be developed with enough flexibility to be used by adults with a counselor, or through the self-help approach. Our research suggests that it would be very possible to develop an easy to use questionnaire that would aid in such decision making. In fact, we have already presented enough information for a basic version of such a computer education assessment device, as well as guidelines for a more sophisticated instrument.

Policy and Administrative Recommendations

The final set of recommendations concerns what needs to be done to facilitate computer education for adult learners at higher, more administrative levels. We have already seen that every other major learner population has considerable governmental, funding and organizational support aimed at facilitating computer education for their respective learning constituents. It is sadly ironic that the single largest group of Americans who are in most urgent need of such attention are not represented in the necessary ways. Even proposed legislation such as the "National Computer Literacy Act" only mentions adult learners in the barest of ways. The following and final set of recommendations is aimed at correcting this situation by addressing the educational, consumer and legislative needs of the adult learner as a distinct and rightful educational group.

1. Adult Educational Materials The development of computer related educational materials suited to the needs of adult learners is a

priority concern. Our examination of textbooks indicates that they are written primarily for high school, college, and professional students. Indeed, one of the first tasks of the MECC was to design educational formats and materials specifically for the high school student. The publishers of educational texts intensely compete for the college market. However, we found only one text that even made a serious effort to address the adult audience. Publishers must be encouraged to see adults as a significant market population. Writers should be encouraged to develop texts that go beyond the "me and my personal computer", or "computer dictionary" popular introductory books. Adults need texts that are clearly written, express basic concepts in common language, and include exercises and examples that are suited to adults. The focus of such texts should be an introduction to the use of the machine, basic operations, and especially applications and software. The current emphasis on basic programming is not only misplaced for the adult learner, but it may actually be destructive. Many older learners who could learn to use a computer in a practical way simply turn away from jargonistic, mathematically and programming oriented learning formats ... and rightly so considering their needs and time limitations.

2. Specialized Teacher Training Specialized workshops and training programs for teachers of adults are indicated. Just as there is a shortage of computer teachers in the high school and college settings, instructors for adult learners are limited. The so called yukkie analogy mentioned in the Hearings is even more common in adult computer learning. Typically, the adult must often suffer through a teacher that is trained or better suited for teaching other kinds of

populations. Teachers must be trained in the practical techniques of computer education such as those used in the private sector, as well as the standard techniques of adult education. Many colleges are currently retraining their faculties to teach basic computer courses (Turner, 1984). The same kind of specialized and funded training support is needed for the adult sector.

3. Funding Support Naturally, most of these recommendations require some form of financial support. Funds for research and training are required because those who are qualified to do such work are already in high demand. There is far too much competition from more lucrative markets (such as the development of educational software for teaching) for qualified individuals to spend time on creating good materials for non-technically oriented adults. Government support is needed to stimulate more experienced researchers to study adults in this area. Such funding will also stimulate graduate students and academic policy makers to devote more time to older learner needs. Also, the kinds of policy changes that are necessary to free up educational loan money or tax deductions for certified computer education for adults must be executed at the legislative level. Such changes would require administrative and/or political leadership and commitment at the state and federal levels.

4. Adult Computer Education Sources (ACES) The final recommendation concerns a way to advance the cause of computer education and training for any particular learner group that is of proven and superior value. Our research unequivocally indicates that the most effective and efficient way to facilitate the acquisition of computer skills for any

group is through the creation of a central, formal and funded catalyst orgnization. More specifically, we have seen that the MECC, EDUCOM and ACM are all organizations which have successfully advanced the research, teaching, and legislative positions of their respective learning constituents far beyond any other type of activity. Therefore, we propose the formation of the adult equivalent of this administrative and organizational tool. The Adult Computer Education Source (or "ACES") would be such an organization. This program would have two major aims. One is to advocate the needs of the adult learner as a large and rightful learning group in the appropriate educational and legislative spheres. The other is to actively represent adult learners in the research, training, educational publishing, and administrative arenas. The specific responsibilities of the organization would consist of the following functions and activities.

Information Gathering Activities Since there is no organization dedicated to gathering information about adult computer learning, a primary function of ACES would be to gather, catalog, and house such knowledge. The initial focus would be on tracking research projects, educational market needs, legislation, as well as public and private sector funding trends and sources. This activity would include the development of active information files for all these areas as they emerge across the nation. The chief value of this function is that it facilitates the development of an organized body of knowldge.

Dissemination Function In addition to the collection and coordination of information, ACES would also function as a resource center. The information can be shared with other organizations, projects, and institutions. Methods of distribution could include written correspondence, a telephone hot line, monthly newsletters, seminars and convention presentations, depending on funding support levels. The value of such an information clearing house is that it both avoids duplication, and facilitates education. For instance, program developers would have a central resource to turn to in the creation of computer related adult education, vocational and job retraining programs. This kind of resource can save considerable development time, and increase cost effectiveness by allowing developers to examine practices which have proven to be effective. Model programs like Summer Tech '83 and '84 could be modified to local need, providing developers are aware of such practices. Of course, ACES would also help people to avoid those practices which have proven too costly or problematic. Eventually a public access computer bulletin board service might also be a possibility.

Research and Teaching An advanced function of the organization would be to represent older learners in the academic and educational sectors. Developing recommendations for research priorities and teaching practices would be a desired activity. Regular communication with large scale organizations such as the Department of Health and Human Services, the American Association of Higher Education, the National Science Foundantion, the military (Benderson, 1983) and the proposed regionally oriented Learning Research and Development Centers (ASERI) would be an important activity. Original research might be a priority once the organization was firmly established.

Policy Function ACES' final function could ultimately prove to be its most important. Anyone who takes the time to read the Hearings will discover three things that can concern adults. The first is that there are many distinguished legislators and educators who are actively concerned with the problem of computer education. Second, considerable money has been, and will be, spent on computer education for high school and college students. Finally, it is important to remember that adults are scarcely mentioned in spite of their most urgent needs. ACES would seek to change this situation by representing the average, unsupported adult learner in the policy making and administrative areas at the state and national levels.

Initial Structure The initial structure of an organization like ACES is directly dependant upon the level of funding support that it receives. However, there are minimal administrative and personnel requirements that are necessary to assure basic operation and success. For instance, the academic sector is most likely to be able to provide the kinds of physical and institutional in-kind contributions that most funding sources require. Also, there are three additional advantages of housing ACES in an academic setting: it is geared toward education; it is already hooked into the educational structure; and the kinds of individuals who are most qualified to operate such an organization are most likely to be located in such a setting. Minimal staff requirements include a project administrator with established organizational experience, a research director who is qualified in adult computer education, an assistant and some form of secretarial availability. Minimal equipment would include a computer (which can often be donated by the institution), the usual kind of secretarial supplies, a photocopy equipment, and an answering machine. Of course, a good staff would also seek out additional public and private sector funding sources as a regular program activity. These and other income generating sources such a fee-for-services format are important to sustaining the organization beyond the initial funding period.

Conclusion

This handbook was prepared on the basis of research that was aimed at developing a first clear and comprehensive look at the subject of computer education for adults in America. The current educational status, the structure of the learning process and patterns of the "typical" adult learner were all examined in some detail. In addition to original research such as the survey, the project resulted in a number of relatively specific research, teaching, learning and administrative recommendations that are designed to facilitate the acquisition of computer skills for adults. Rather than merely recapitutaling the findings and suggestions, we would like to end the handbook in further service of its practical aims. In short, we urge you, the reader, to consider the recommendations carefully, and conclude by thematizing the most important point one more time.

It is unavoidably true that the future of millions of Americans can be helped or hurt by the introduction of the computer into everyday life. The evidence indicates that while all of the recommendations are helpful, a program like ACES can potentially help the greatest number of adults most efficiently. Therefore, we have freely provided the basic outline for such a project. A potential grant writer may wonder why we did not keep it for our own development. Two reasons prompted the action. First, ACES is a good idea. In fact when this project was presented at NECC '84, members from several organizations asked us to provide just this service. Second, the implementation of the project is more important to us than who gets to do it. Of course, the degree to which a program like ACES can fulfill its mission depends on the budget. However, even a modest degree of support would create the first national adult computer literacy organization. A strategic outlay of initial monies at this relatively early time may result in avoiding vastly greater economic and social expenses in the not too distant future. We were warned that the computer has the capacity to alter the human world some twelve years ago. Such change is already upon us, and the time to act is now!

Glossary of Commonly Used Terms

ACES -- Adult Computer Education Sources, a proposed national adult computer education organization.

ACM -- Association of Computing Machinery, a major, parental computer information gathering organization.

Adult/Older Learners -- Learners who are age 25 or more.

AFIPS -- American Federation of Information Processing Society.

ASERI -- The computer age, Computers in education: realizing the potential, U.S. Government Printing Office, Washington, D.C., 1983.

CMU -- Carnegie-Mellon University, Pittsburgh, PA.

EDUCOM -- A college oriented computer education project, Princeton, New Jersey

ETS -- Educational Testing Service, Princeton, New Jersey.

Hearings -- Computers and Education, Hearings before the Subcommittee on Investigations and Oversight of the Committee on Science and Technology, U.S. House of Representatives, September 28, 29, 1983.

IFIPS -- International Federation of Information Processing Society, an international computer information organization.

LSI -- Kolb's Learning Style Inventory

MCSR, Computer learning and the public need, MCSR technical report 84-3, Minnesota Center for Social Research

MECC-- The Minnesota Educational Computing Consortium.

NECC -- The National Educational Computing Conference, an annual national conference on the state-of-the-art in computer education, Supported by ACM.

Summer Tech -- A massive community oriented computer education program designed and sponsored by the Ohio State University, and the City of Columbus, Ohio.

Seybold Report, Seybold Publications, Media, Pennsylvania, a private research corporation.

SIGCUE -- Special Interest Group for Computer Uses in Education, sponsored by ACM.

SIGCPR -- Special Interest Group for Computer Personnel Research, sponsored by ACM.

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